User Participation in Standardisation Processes - Impact, Problems and Benefits

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This is to certify that this thesis entitled

"User Participation in Standardisation Processes -
Impact, Problems and Benefits"

has been composed entirely by myself, and that it represents my own work.

(Kai Jakobs)

Abstract

The thesis first provides an in-depth review of the relevant literature on innovation processes, the social shaping of technology, and on standardisation. In addition, the crucial term 'user' is thoroughly discussed. This review serves as the framework within which subsequent analyses will be placed. Subsequently, a brief account of the methodology applied to compile the primary data is given. As a major part of the survey was done via e-mail, this also includes a discussion of the pros and cons of this medium for doing survey research. Some rather more 'technical' background material is provided in chapter four. The formal processes adopted by the standards setting bodies represented in the study are briefly described, and the functionalities of the two messaging standards looked at (i.e. the ITU-T X.400 and X.500 series of recommendations on e-mail and the directory service, respectively) are outlined.

The remaining chapters present an analysis of the compiled data, and offer some conclusions. In particular, I discuss to what extent corporate users' requirements on messaging services are met, and identify the remaining gaps. Different categories of 'strategies' for the introduction of an electronic mail service in an organisational environment are identified; these are reviewed as well. Subsequently, some issues surrounding the standardisation process are addressed. The initial idea of this process is developed into a more realistic model, largely based on comments made by committee members in the survey. User participation in this process is another focus; the associated pros and cons, as perceived by different stakeholders, are presented and discussed. Finally, I attempt to form a coherent picture out of the various topics addressed so far. The existing relations between innovation theory, user requirements, introduction strategies, and standardisation processes are pointed out, and some conclusions that can be drawn from these relations are presented. In particular, a new model of the standardisation process is introduced, and its benefits - and potential problems - are discussed. This model takes into account the different aspects discussed previously.

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List of Acronyms

ACTS	Advanced Communications Technologies and Services
AD	Area Director
ADMD	Administration Management Domains
ANSI	American National Standards Institute
AS	Applicability Statement
ATM	Asynchronous Transfer Mode
ATM	Asynchronous Transfer Mode
AU	Access Unit
AUR	Agreed User Requirement
BSI	British Standards Institute
CCIF	International Telephone Consultative Committee
CCIR	International Radio Consultative Committee
CCIT	International Telegraph Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee
CCR	Commitment, Concurrency and Recovery
CD	Committee Draft
CEU	Commission of the European Union
CFS	Common Functional Specification
CIM	Computer Integrated Manufacturing
CSMS	Cyclic Stage Model of Standardisation
DAP	Directory Access Protocol
DIB	Directory Information Base
DIN	Deutsches Institut für Normung
DIS	Draft International Standard
DIT	Directory Information Tree
DL	Distribution Lists
DL	Distribution List
DN	Distinguished Name
DQDB	Distributed Queue, Dual Bus
DS	Directory Service
DSA	Directory System Agent
DSP	Directory System Protocol
DUA	Directory User Agents
DUA	Directory User Agent

ECMA	European Computer Manufacturers Association
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange for Administration, Commerce and Transport
EEMA	European Electronic Messaging Association
EFTPOS	Electronic Funds transfer at Point-of-Sale
EMA	Electronic Messaging Association
ETSI	European Telecommunications Standards Institute
EWOS	European Workshop on Open Systems
FDIS	Final Draft International Standard
FTAM	File Transfer, Access and Management
GII	Global Information Infrastructure
HCI	Human-Computer Interaction
HTTP	Hypertext Transfer Protocol
IAB	Internet Architecture Board
IBC	Integrated Broadband Communications
ICT	Information and Communication Technology
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IERG	Internet Engineering Steering Group
IESG	Internet Engineering Steering Group
IETF	Internet Engineering Task Force
IFIP	International Federation for Information Processing
IP	Internet Protocol
IPM	Interpersonal Messaging
IS	International Standard
IS	Information System
ISA	International Federation of the National Standardizing Associations
ISO	International Organization for Standardization
ISOC	Internet Society
ISP	International Standardized Profile
IT	Information Technology
ITU	International Telecommunication Union
ITU-T	International Telecommunication Union - Telecommunication Standardization
ITUG	International Telecommunications User Group
IWU	Interworking Unit
JTC 1	Joint Technical Committee 1
LAN	Local Area Network
MAP	Manufacturing Automation Protocol
MD	Management Domains
MS	Message Store
MTA	Message Transfer Agent
MTS	Message Transfer System
NII	National Information Infrastructure
NP	New work item proposal
O/R	Originator/Recipient
OECD	Organization for Economic Co-operation and Development
OMG	Object Management Group
OPS	Open Profiling Standard
OSI-RM	OSI Reference Model
PAS	Publicly Available Specification
PDAU	Physical Delivery Access Unit
PKCS	Public Key Cryptosystems
PrMD	Private Management Domains
PTT	Post, Telegraph and Telephone administration
RACE	Research and Development in Advanced Communications Technologies in Europe

RDN	Relative Distinguished Name
RFC	Request for Comments
ROA	Recognised Operating Agency
SC	Sub-committee
SDO	Standards Developing Organisation
SIO	Scientific or Industrial Organisation
SME	Small to Medium Enterprise
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SPAG	Standards Promotion and Application Group
SST	Social shaping o technology
T1	Accredited Standards Committee for Telecommunications - One
TAG	Technical Advisory Group
TC	Technical Committee
TCP	Transmission Control Protocol
TERENA	Trans-European Research and Education Networking Association
TOP	Technical and Office Protocol
TSB	Telecommunication Standardization Bureau
UA	User Agent
VE	Virtual Enterprise
WEMA	World Electronic Messaging Association
WG	Working Group
WP	Working Party
WTSC	World Telecommunication Standardization Conference
WWW	World Wide Web

Papers Published During the Course of the Thesis

Jakobs, K.; Procter, R.; Williams, R.: Usability vs. Standardization? Proceedings CHI '95 Research Symposium, ACM, 1995.

Jakobs, K.: Future (Data) Communication Networks - The Challenge to (Public) Service Providers. Computer Communications, vol. 18, no. 11, Butterworth-Heineman, 1995.

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Copies of these papers can be found in Appendix B.
Permissions to include these papers in the thesis have been obtained.

Chapter 1

Introduction and Motivation

"Standards are not only a technical question. They determine the technology that will implement the Information Society, and consequently the way in which industry, users, consumers and administrations will benefit from it. They play an important role in cooperation and competition between companies, are a key element for the effectiveness of the Single Market and are essential for the competitiveness of European industry" [CEU 96].

Our world is becoming networked. The envisaged Global Information Infrastructure (GII) is going to have a profound impact as the major enabler of the frequently predicted move from an industrial society to the information society. In the meantime the different government initiatives towards national or regional information infrastructures are gaining momentum. This holds particularly for the US, the Pacific Rim and Europe, where the 'Bangemann Report' [Bang 94] identifies ten application areas to launch the future information society, including teleworking, distance learning and health care. Likewise, major developments take place in the domestic sector. Here as well stand-alone computers are bound to vanish sooner or later, as ISDN interconnectivity and access to the Internet are becoming increasingly commonplace. As a consequence of these trends network externalities will become more and more visible, and will in turn further speed up the networking process in the non-commercial sector. It may take some time, but ultimately almost every organisation, company, school and household will be interconnected to the GII. Or so they say; this frequently evoked development can only happen if globally agreed standards will be available upon which the GII can be based. The single components that will eventually establish the GII are of an extreme heterogeneity, which extends to the physical medium, the communication services and protocols, the application services, and the end systems [Schoen 95]. These components need to be interconnected to enable the required seamless interoperability between heterogeneous systems and across different networks. As of today, this can only be achieved to a comparably rudimentary degree. Accordingly, a number of new standards have already originated from GII-related activities, and many more are likely to emerge in the near future. In addition, a plethora of existing standards and specifications have been identified as being of importance[1]. These are particularly critical as the GII will not be designed from scratch. Rather, there is the need to incorporate the huge installed base of legacy technology, as well as to provide mechanisms to cater for future systems, the nature of which is not yet predictable (see also [Alex 95]).

Thus, no overall standard will ever emerge in this environment; indeed, it is most unlikely that even a small number of sector- or application specific standards will be able to cover all different aspects of the system's functionality. Rather, a variety of interface and component standards may be expected. These standards will play a crucial role as the integration of networks and services approaches the ubiquitous GII. Indeed, it may be anticipated that adequate standards will be similarly important for the GII as the GII itself will be important for society as a whole. If they do not emerge the whole concept is bound to fail, and the GII will never materialise [Hanra 95].

Accepting the importance of standards for future developments not only with respect to the GII, but for information technology in general, implies that the process leading to such standards should be of particular interest as well.

Two notions, apparently complementing each other, marked the beginning of the work described in this thesis. First, in the late eighties to mid nineties standards setting organisations were complaining about the perceived severe lack of participants from user companies (see e.g. [ITU 94c]). Some went to great lengths to increase the number of participants representing user companies in an attempt to improve their

[1] Several hundred standards and specifications, from very different sources, have so far been identified by the EU's 'Open Information Interchange Initiative' as being relevant to GII activities. Areas covered include e.g. colour information interchange, video interchange, data transfer, EDI, electronic conferencing, and geographic information systems [CEU 97].

standards' visibility and their chances of survival in the market place [ETSI 92]. Second, by that time corporate electronic mail systems had become increasingly popular. Surveys reported a 100% increase in the number of business e-mail users from 1991 to 1994 (see eg [EMA 93]), and predicted an annual market growth of 16% until the year 2000 [Ovum 94]. Yet, users did not seem to be particularly happy with their respective messaging services. Several major restructuring projects were under way at about the same time (see e.g. [Breck 93], [Corb 90], [Dyk 91], [Harv 91], [Harv 92], [NPR 94]), aiming to establish more usable and useful systems, to improve interoperation, and to increase the acceptance of corporate e-mail in general. Another crucial notion underlying these restructuring efforts was the widely perceived increasing importance of inter-business interoperability, for which standards are a critical prerequisite. Moreover, given that it was in the mid seventies that wider commercial use of e-mail commenced, sufficient working experience should have accumulated by now to enable informed opinions about its usefulness and drawbacks. Yet, it is still a relatively new service, in all likelihood not as entrenched in businesses routines, and its specifications not as well-worn as many others. It was therefore hoped that there was still a chance to do something about identified shortcomings. Finally, it must be said that being reasonably familiar with the technology was another criterion.

Taken together, these developments and notions suggested that unhappy users were, at least partly, a result of their under-representation in the standards setting committees, which therefore failed to incorporate user requirements into the standards, resulting in systems that did not live up to their users' expectations. This, in turn, led to my first working hypothesis that if these requirements were conveyed to the committees many problems would vanish. Consequently, the first approach was to compile user requirements, both from literature and through surveys, map them onto the functionality described in the standards, specify the enhancements necessary in the light of the new requirements and forward them to the committees in charge. That is, the idea was to act as some sort of proxy for the user community and to make their voice heard in the committees.

Unfortunately, however, it turned out that neither the (comparably few) articles and reports on user requirements that could be found in the literature, nor the users themselves were in a position to identify much more than just the odd specific technical requirement that was actually rooted in shortcomings of the standards specifications. Rather, most of the requirements identified either related to issues outside the scope of standardisation (e.g. local integration of user agents into an existing work environment), or could be traced back to services or products that did not implement the full standard. To make things worse, almost all requirements that actually did relate to the standards were extremely generic. On the other hand, many users still expressed a feeling of being uncomfortable with their corporate systems. The obvious next step, therefore, was to find out why users were unhappy with their e-mail systems despite the apparent lack of requirements for additional functionality.

To answer this question two lines of research were followed. One looked at the underlying processes that actually generated the standards, to try and find out whether problems could be linked to certain elements of these processes. It should be noted, however, that this exercise did not aim at finding and analysing some kind of 'standards war', as e.g. the recent struggles for HDTV standardisation (see eg [Cave 91]). Rather, the focus was - within the framework of already existing standards - on the 'lowest' level of the whole standards setting process, i.e. on the technical work groups, where the basic technical decisions (as opposed to political or, to a lesser degree, strategic ones) are being made. The interesting issues in this context included the WG members' views on increased user participation (what the official sources of the standards setting organisations were so desperately trying to achieve) in general, if, how and when it should be attempted to achieve, and its potential benefits and drawbacks. On the other hand, user representatives could comment on their perceptions of potential benefits, if any, they would associate with participation in standardisation, and on alternative ways they would pursue to get the functionality they need. The basic idea here was to identify possible ways in which either users could advantageously participate in standards setting, or could put their requirements across in some other way. Such knowledge could be particularly useful for the upcoming standardisation efforts concerning services to be standardised within the framework of the much discussed Global Information Infrastructure (GII).

The second focus was on the respective 'histories' of corporate messaging, i.e. its diffusion, adaptation and implementation. It was most likely that different introduction strategies had been employed by the various companies. Moreover, the supporting measures offered, like e.g. end-user training and help facilities, could also be assumed to differ. Accordingly, the degrees of end-user acceptance could be expected to vary considerably between the companies.

Inadequate implementation strategies are likely to be part of the explanation for the deficient usefulness attributed to many corporate systems. Less obvious, though, there might also be a link between the respective corporate messaging history and the companies' reluctance - or possibly inability - to play an active role in the standards setting process. If it had indeed been inability on the users' side thus far, this would have a major impact on the evaluation of the value of user participation in standards setting. Moreover, it would imply that requirements will eventually surface once sufficient expertise on the users' side were accumulated and new ways of using e-mail services identified. Indeed, it would possibly raise questions regarding the design of the current process in general.

The implementation aspect is clearly part of a broader issue - that of innovation. Thus, a closer look at the relation between the processes of standardisation, innovation and implementation was an obvious next step, especially since the treatment of this relation in the literature is surprisingly sketchy. This is all the more astonishing as the crucial impact standards (as opposed to, say, 'widely used technical specifications'; these two terms are frequently used synonymously in the literature) have on innovation processes. This impact is becoming increasingly visible - and indeed instrumental - during the current early steps toward the GII. Thus, the role of, and the mutual impact between standardisation and implementation was studied as well.

To summarise, the ultimate major goal of this thesis was to find out if, and to which degree, users are in a position to increase usability and usefulness of products based on the outcome of standards setting processes. In particular, this included the specification of a proposal how to modify this process accordingly, if need be.

The resulting research questions that are to be answered can be put as follows:

- Are the processes of innovation and standardisation related? If so, what is the nature of this relation?

- Is the promotion of increased user participation a suitable means for producing useful standards in the IT domain? What else can be done to achieve this goal?

- In which respect need the processes adopted by voluntary, consensus based standards setting bodies be changed to enable the production of IT standards that meet user needs?

The remainder of this thesis is organised as follows: chapter two will provide an in-depth review of the relevant literature on innovation processes, the social shaping of technology, and on standardisation. In addition, the crucial term 'user' will be thoroughly discussed. This review serves as the framework within which subsequent analyses will be placed. Chapter three gives a brief account of the methodology applied to compile the primary data. As a major part of the survey was done via e-mail, this also includes a discussion of the pros and cons of this medium for doing survey research. Some rather more 'technical' background material is provided in chapter four. The formal processes adopted by the standards setting bodies represented in the study are briefly described, and the functionalities of the two messaging standards looked at (i.e. the ITU-T X.400 and X.500 series of recommendations on e-mail and the directory service, respectively) are outlined.

The remaining chapters present an analysis of the compiled data, and offer some conclusions[2]. In particular, chapter five discusses to what extent corporate users' requirements on messaging services are met, and identifies the remaining gaps. Different categories of 'strategies' for the introduction of an electronic mail service in an organisation could be identified; these are reviewed as well. Subsequently, chapter six addresses some issues surrounding the standardisation process. The initial naive idea of this process is developed into a more realistic picture, largely based on comments made by committee members. User participation in this process is another focus here; the associated pros and cons, as perceived by different stakeholders, are presented and discussed. Finally, chapter seven attempts to form a coherent picture out of the various bits addressed so far. The existing links and relations between innovation theory, functional requirements, introduction strategies, and standardisation processes are pointed out, and some conclusions that can be drawn from these relations are presented. In particular, a new model of the standardisation process is introduced, and its benefits - and potential problems - are discussed. This model takes into account the different aspects discussed previously.

[2] It should be noted that the summaries and analyses, presented in sections 5.3 and 6.3, refer primarily to the respective chapter. The overall analysis is presented in chapter seven.

Chapter 2

Literature Review

This chapter will critically review those segments of the literature that are of particular interest for my subsequent considerations. Based on an analysis of the literature on the social shaping of technology, i.e. particularly how information technology forms, and is formed by, its environment, I will look at some aspects that need to be addressed in order to better understand the mechanisms influencing this interplay. Accordingly, the following section will address standards-related issues, including definitions, a classification, a description of today's standardisation universe, and a discussion of the current standards life cycle. This will be followed by a brief closer look at the economic aspects of standards, and an analysis of what it actually takes to specify a standard that has the potential to survive in the market place. Subsequently, I will give an analysis of the relation between innovations and standards. Finally, I will point to some lessons that standard setters can learn from the disciplines of software engineering and business studies.

2.1 Standards and Standardisation - A General Overview

This section addresses some of the aspects that together establish what could be referred to as the standards problématique [Hawk 95d]. The process of standardisation cannot be regarded as a simple, one-dimensional activity required to lay down technical rules and guidelines, taking place in a removed world of its own. Rather, it must be considered in conjunction with the environment within which it takes place. It follows that very different facets of standardisation need to be taken into account when trying to actually understand this process.

Standards will gain additional significant importance in the light of the various surfacing National Information Infrastructures (NII), ultimately to be integrated into one Global Information Infrastructure (GII). These infrastructures will be established by very heterogeneous networks providing different communication protocols. Thus, compatibility standards will be a sine qua non [Schoen 95]. They will have to support applications yet to be developed [Brans 95] and will therefore exhibit characteristics very different from those already known from current information and communication systems. This, in turn, means that the GII will require major re-considerations of the communication services to be provided and prior to that, of course, standardised [Hanra 95]. This is only one example how standards are having a major impact on a whole industry - and indeed the society - which makes for example the analysis of standards and the underlying processes in economical terms a crucial exercise.

Even if we disregard social, moral and religious rules for the moment, standards - still in a very general sense - have been with us for quite some time: about 5,000 years ago the first alphabets emerged, enabling completely new forms of communication and information storage. Some 2,500 years later, the first national, coin-based currency, invented by the Lydians, established the basis for easier inter-regional and even international trading [Ency 87]. The industrial revolution in the 18th century and, more so, the advent of the railroad in the 19th century resulted in a need for technical standards, which was once more reinforced when mass production generated a demand for interchangeable parts. In parallel, the invention of the electric telegraph in 1837 triggered the development of standards in the field of electrical communication technology. In 1865 the International Telegraph Union - to become the International Telecommunication Union (ITU) in 1932 - was founded by twenty states [ITU 93b]. The other major international standards setting body, the International Organization for Standardization (ISO), was established in 1947.

However, only during the last ten or fifteen years has the economical importance of standards been recognised, and standardisation has been accepted as a strategic tool of major importance. At the same time, the number of 'standards setting bodies' has soared, as has the number of published 'standards' (for a definition of standards, and the explanation of the quotation marks, see sect. 2.1.1.1). Almost countless voluntary organisations and, particularly, industry fora keep springing up, at a rate of about one major consortium per quarter [Carg 95], many of which are devoted to 'standards' setting. Moreover, researchers from various disciplines (including, but not limited to, psychology, economy, sociology, and computer science) have begun to analyse different aspects of standards setting. Summaries of some of their insights and results will be presented in this section. However, some limitations also apply. In particular, I am not going to discuss political aspects (see e.g. [Gensch 95], [Stein 95a], [OTA 92]) and intellectual property rights (IPRs; see e.g. [Ask 95], [Ellis 95], [Farr 95], [Gilli 96], [Shur 95], [Smoot 95], [Spr 92b]).

2.1.1 What's a Standard Anyway?

The term 'standard' defies easy access. It covers too broad a variety of totally different fields, from societal norms and moral values to bolts, paper sizes and character sets. Similarly different are the sources from which standards emerge, including legislative bodies, philosophers, and dedicated standards setting bodies.

If pushed, everyone will have at least a vague idea about what a standard is (or should be), and what it is supposed to achieve. However, as usual, it is the details that are most tricky. Therefore, a common definition for 'standard' would be most helpful. The course of the search for this definition unearths a wealth of different explanations of the term 'standard', from the very general to others confined to a single field to those limited in one respect or another.

2.1.1.1 Definitions and Classifications

The following definitions are listed to provide an idea of what a standard is according to a variety of different sources, from the very general to the (technology) specific:

1 *"The acceptable behaviour and mores of a society and culture."* [Carg 89].
In some way this is the broadest definition, yet at the same time largely limited to moral and ethical issues, thus ignoring the more materialistic technological context within which standards play an important role as well (unless you consider technology as a special expression of 'behaviour').

2 *"The deliberate acceptance by a group of people having common interests or background of a quantifiable metric that influences their behaviour and activities by permitting a common interchange."* [Carg 89].
Still a rather general definition, regarding a standard as little more than some common ground. There may be a certain view towards information technology by associating standards with 'permitting a common interchange'. However, this association is very indirect and probably unintentional.

3 *"An authoritative principle or rule that usually implies a model or pattern for guidance, by comparison with which the quantity, excellence, correctness etc. of other things may be determined."* [Web 92].
Perhaps the most complete definition, that is not limited to any specific field, but can be applied to moral and ethical issues as well as to technology (little wonder, though, as it was taken from a dictionary). At the same time, however, this universality is a weakness, as it offers little concrete guidance.

4 *"A prescribed set of rules, conditions or requirements concerning definition of terms; classification of components; specification of materials, performance, or operations; delineation of procedures; or measurement of quantity and quality in describing materials, products, systems, or practices."* (quoted in [OECD 91]).
According to the source this definition is specifically aimed to the field of IT; however, it can easily be applied to other fields of engineering as well. A potential obstacle to it is the suggested direct association of a standard with a product.

5 *"A set of technical specifications that can be adhered to by a producer, either tacitly, or in accord with some formal agreement, or in conformity with explicit regulatory authority."* (quoted in [Mans 95]).
This definition exhibits a close relation to products in general, and can thus easily be applied to IT products and services. Being very pragmatic it fails, however, to recognise that a standard may have many more facets to it than just the 'technical specification' a producer can adhere to. Even more so than the definition above this one rather more defines a standards profile or a functional standard than a base standard.

6 *"The authorized exemplar of a unit of measure or weight; e.g. a measuring rod of unit length; a vessel of unit capacity, preserved in the custody of public officers as a permanent evidence of the legally prescribed magnitude of the unit"* [Ency 87].
This definition is given in the Oxford English Dictionary. It quite accurately describes how the old bases for SI units (e.g. meter or liter) were established and kept. Unfortunately, it can hardly be applied to anything else.

Given the respective specific limitations and shortcomings of the above definitions it appears that yet another one is needed for the purpose of this work which is, after all, limited to information technology. Thus, in the following the term 'standard' will have the following meaning (unless stated otherwise):

"A publicly available definitive specification of procedures, rules and requirements, issued by a legitimated and recognised authority through voluntary consensus building observing due process, that establishes the baseline of a common understanding of what a given system or service should offer."

This definition restricts the scope of what is colloquially referred to as a standard in three ways: firstly, it includes only base standards (the 'baseline'); as opposed to functional standards or profiles, which rather more address implementation and interoperability issues. Secondly, it limits the sources from which a standard may emerge to 'recognised authorities'. In particular, this excludes specifications issued by self-styled industry fora like e.g. the ATM-Forum (which may - and do - contribute to standardisation within e.g. ITU). Finally, as standards are said to be established 'through voluntary consensus building', this definition also excludes legislation from being seen as standards. Thus, the sources from which standards may emerge are limited to recognised national, regional or international standards setting bodies, such as e.g. BSI[3] in the UK or DIN[4] in Germany, ETSI[5] in Europe, and ITU or the IETF[6] at the global level, respectively. These organisations are typically referred to as SDOs[7]. These limitations appeared useful as this thesis is only concerned with voluntary base standards. At the same time, however, this is also a weakness, as it excludes so called de-facto or industry standards (see below). Standards are the result of a standardisation process, which itself can be described as:

"..... the voluntary and methodical harmonisation of material and non-material objects undertaken jointly by the interests concerned for the benefit of the community as a whole. It shall not lead to individual interests gaining a special economic advantage and requires consensus agreement between all parties concerned." (quoted in [Repu 95]).

There exists an almost impenetrable maze of what is generally called 'standards', ranging from company specific rules, over regional and national regulations, up to

3 British Standards Institute, the UK national standards setting body.

4 Deutsches Institut für Normung, the German national standards setting body.

5 The European telecommunications Standards Institute.

6 The Internet Engineering Task Force, the standards setting body of the Internet.

7 Standards Developing Organisations. Whereas there is typically one SDO per country in Europe, an abundance of such organisations is available in the US, where standardisation in general is far more decentralised and market driven.

globally accepted standards[8]. Moreover, one may distinguish between different types of standards: there are voluntary, regulatory, de jure, de facto, pro-active, reactive, public, industry, and proprietary standards; this list is by no means exhaustive. Accordingly, a variety of different classification schemes has been proposed for standards, their different respective scopes, and the originating processes. [Krech 96a], for instance, proposes a four-level classification, whereby each class is related to the previous, but introduces an additional level of variation (see Table 2.1.1).

Classes of Standards	Examples	Purpose	Effect
Units	Meter (length)	Sameness	Replication
Similarity	Character sets	Repeatability	Compatible with like
Compatibility	Group 3 facsimile, X.25 interface	Interworking	Transmitter compatible with receiver
Etiquette	CSMA/CD	Expendability	Negotiate the variation

Table 2.1.1: The Four Classes of Standards (according to [Krech 96a])

This classification nicely matches the increasing complexity of standards, typical particularly for the IT sector. A number of other categorisations have been proposed in the literature[9]. The more popular ones include (see also [Hogan 97]):

- **voluntary vs statutory**

  This classification indicates the different natures of the underlying processes as well as the legislative status of its result.

  A voluntary process is characterised through the lack of both intrinsic benefits associated with participation and penalties for non-participation. Voluntary processes tend to be comparably slow, but this slowness is (more or less?) compensated by the wide range of input that goes into the final specification, and its resulting broad acceptance. Adherence to such standards is voluntary as well; they are a means to 'persuade' the market to move into a certain direction deemed beneficial. This process is embraced by all SDOs. Another crucial characteristic of voluntary standards is the observation of 'due process' [Gray 95]. In short,

8 Please note: for the sake of a broad discussion, throughout this section the term 'standard' will be used according to definition four given above.

9 For categorisations of standards, and descriptions of these categories see e.g. [Hanra 95], [Leve 95], [OTA 92], [Salt 95], [Upde 95].

that is, ".. *any 'person' with a direct and material interest in the activity's outcome has a right to participate in the activity.*" [Baro 95].
A statutory process, on the other hand, can only be initiated by some legislative authority, and its outcome will typically materialise faster, but because of its very nature may command less support from the affected communities, who may not have had an adequate say during the process. However, everyone under the legislation of the issuing authority will have to obey those standards.

- **de jure vs de facto**
  This very popular classification should primarily refer to the different ways the respective standards emerge; this includes the characteristics of the respective originating organisations. Frequently, however, this categorisation is used in a way contradicting the above classification, in that the attribute 'de jure' is associated with standards that emerge from an SDO through a voluntary process, and which are indeed only voluntary in nature. Standards that emerge purely through market forces (maybe through the dominant position of one or a group of players) are referred to as being 'de facto'. With the increasing complexity of the world of standards, and the cross fertilisation between SDOs and consortia, this distinction will eventually become obsolete.

- **public vs industry vs proprietary**
  This distinction is similar to the above one. Typically, standards published by SDOs are referred to as public, and de-facto standards, which in most cases originate from a single powerful company or a consortium, are referred to as industry standards. Likewise, proprietary standards have been defined by a company, but in contrast to industry standards the specifications have not been made public and are owned by the specifying company.

- **proactive vs reactive**
  These categories (also referred to as 'anticipatory' and 'traditional', respectively) are used to distinguish between the ways the standards emerge, i.e. based on an already existing product (reactive) or in anticipation of future demands and requirements (proactive). In the IT-domain standards setting used to be reactive, this appears to have changed somewhat recently (cf. e.g. [Bach 95]). OSI, ATM and ISDN are among the more popular examples of proactive standards. Obviously, any attempt to create proactive standards bears a major risk of failure.

- **base vs functional**
  Both ITU-T and ISO, as well as the single national SDOs, produce base standards. These are characterised by the fact that they only address functional matters, as opposed to implementation-specific issues. Particularly in the wake of OSI standards, with their numerous options and even different protocols for the single layers, interoperability problems arose since implementations using different options were no longer able to interoperate, although being standards compliant. Functional standards were introduced to cope with this problem. They identified standard profiles; a profile defines a hierarchy of protocols, and the options to be used within each protocol layer. Today, several organisations are working on functional standards (e.g. EWOS).

Standards setting organisations may be characterised according to the respective type and by whom they are controlled (see Table 2.1.2).

(Standards) Organisation	Type	Controlled by (officially)	Produces
ITU	global governmental standards authority	governments	voluntary base standards
ISO/IEC	global private sector standards authority	national standards authorities	voluntary base standards
ETSI	European membership standards authority	members	voluntary base standards
IETF	global (?) independent consortium	individuals	implementation oriented base standards
ANSI	US private sector standards authority	members	voluntary base standards
(ATM Forum)	global industry consortium	members	technical specifications
(EWOS)	European membership standards profile developers	members	functional standards

Table 2.1.2: Telecommunications Standards Bodies
(based on [Krech 96b])

The different types of 'standards', as well as the underlying processes, can be characterised through combinations of the above attributes. The fact that the ITU produces 'recommendations' already hints at the non-binding nature of the specifications[10] - although it is an international body under a public intergovernmental organisation; the same holds for ISO standards (ISO being a private rather than a treaty organisation). The documents produced by these organisations, therefore, can be described as being voluntary, public base standards[11]. In particular, they should not be referred to as 'de jure' since they do not have any legally binding status per se[12]. As it holds for other SDOs, ITU's and ISO's standards can be either proactive or reactive. On the other hand, it is typically claimed that consortia produce 'de facto' or 'industry' standards (which are not standards at all according to the above new definition, but technical specifications). In any case, these too are voluntary 'standards', they may be proactive or reactive, as well as base or functional. Frequently, as in the case of the ATM Forum, these specifications are subsequently submitted for consideration to ISO or ITU-T. ISO has introduced a mechanism allowing such reasonably mature specifications to proceed more quickly through the single stages of their standards setting process (see sect. 4.1).

The IETF is very much a borderline case. Their process can be easily be identified as being voluntary and public; their documents specify base standards. Specifications emerging through this process are regarded by many as 'de jure' standards (i.e. on a par with e.g. the output of ISO and ITU [Rut 95]), whereas others consider them as mere 'de facto' standards (akin to specifications originating from consortia; as does e.g. the US administration). With some reservations I would subscribe to the former. Reservations firstly concern the term 'legitimated' in my definition of what constitutes a standard; the IETF is really very much a self-appointed authority (as are the IESG, the IAB or the ISOC for that matter[13]). Moreover, the IETF's 'rough consensus' is not quite the same as 'consensus', and very much open to individual interpretation. Finally, none of the relevant IETF documents mentions due process[14] as a guiding principle of their procedure. However, the openness of the procedure, which means

10 At least in theory; ITU recommendations, for instance, have almost always been integral part of the procurement procedures of the national PTTs [Gensch 95].

11 ISO also produces some functional standards, but it clearly focusses on base standards as well.

12 Voluntary standards may obtain such binding status through subsequent legislative procedures, though, in which case they become statutory standards.

13 The Internet Engineering Steering Group, the Internet Architecture Board and the Internet Society, in that order, form the upper levels of the Internet standards setting process (see [RFC 96d] and sect. 4.1.3).

14 Observing due process implies that any affected entity has the right to be heard and to appeal (see sect. 2.1.3.1 for a discussion of the issues surrounding this principle).

that everyone may actively participate in the standards definition process, and the appeal mechanisms established (see [RFC 96a]) should provide a basis upon which due process can be observed. In general, therefore, I would argue that it appears to be justified to consider the Internet standards as exactly that - standards.

To clarify the confusion apparently surrounding the various types of standards, and the different ways the terms are used in the literature, some additional comments and explanations regarding the above classifications may be helpful. It has already been noted that the terms 'de jure' and 'voluntary' are frequently used interchangeably in the literature. The underlying notion is that both refer to organisations widely considered as 'legitimate' sources of standards - as opposed to, for example, the rather more self-styled consortia. Yet, as 'de jure' seems to imply that these standards have been issued by an entity with some kind of statutory power, it should be made very clear that this is not the case, these are truly voluntary standards. Likewise, 'de facto' is frequently used synonymously with both 'industry' and 'proprietary'. Apart from the fact that these refer to very different classes of documents - the former is an 'open' specification, which is publicly available, whereas the latter is, well, proprietary, and possibly safeguarded by patents - these are not really standards at all in the first place. Moreover, 'de facto' could be mistaken for something unique, which is definitely not the case; there may be different competing de facto 'standards'.

Originally, technical standards were exclusively produced by 'official' voluntary standards bodies, like BSI (UK), ANSI (US), or DIN (Germany) at the national, or ISO and ITU at the international level. Yet, their 'official' standards setting procedures are perceived by many as being time-consuming and largely based on compromise (see e.g. [Carg 95], [Isaak 95], [Sol 92]). Moreover, not all important aspects of IT have been addressed by these bodies; for instance, there are no such things as standardised word processors or operating systems. These aspects together with economic considerations led powerful players to try and establish their own proprietary 'standards' (IBM in the sixties and seventies, as well as, to a lesser extent, Microsoft in the nineties are cases in point). Potentially significant economic benefits stood to be gained from successful de-facto 'standards'. They could be developed in-house, and be tailored towards the needs of their producer (and possibly towards those of some major customers). More recently, consortia have been established at an almost alarming rate [Carg 95]. Those aiming at the production of technical specifications hope for greater speed of completion, and that real products can easily be produced subsequently [Oksa 95b]. Moreover, consortium members are likely to subsequently back the specifications they helped design; through vendors developing products incorporating these specifications, and by users actually buying them. Among the members of such consortia, vendors, suppliers of complementary products or services, and some users can typically be found. Even competitors join forces here in order to establish a market (see also e.g. [Will 97a]). Unlike proprietary 'standards', however, consortia specifications (industry 'standards') are normally openly available, to ensure the broadest support and widest dissemination possible. In fact, for such 'standards' wide acceptance is vital, not least because they do not enjoy the blessing of being an 'official' standard, and thus carry less weight for many. They also need to be timely and reasonably well tailored towards their potential customers' needs to be able to either create their own market, or to be condoned by the market.

2.1.1.2 The Standardisation Universe

The maze of standards setting bodies is almost as confusing as the conglomerate of standards itself. Figure 2.1.1 shows the standardisation universe in 1970.

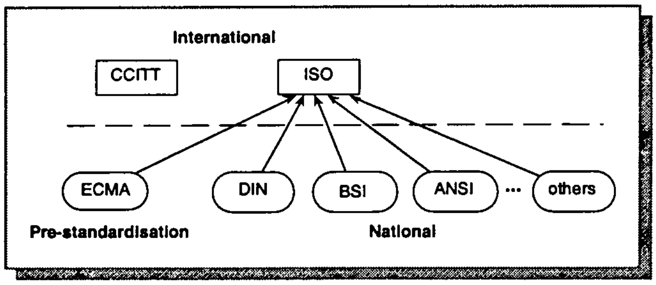

Figure 2.1.1: The IT Standardisation Universe in 1970.

Back in the seventies, the standards setting bodies were few, national bodies contributed to the work of ISO at the international level, which itself was separated from the activities of the then CCITT[15]. The only other international organisation of some importance was ECMA[16].

Since than, the number of players in the global standardisation arena has multiplied, notably industry consortia, regional organisations such as ETSI in Europe and T1[17] in the US, organisations establishing functional standards and profiles (e.g. EWOS[18]),

15 International Telegraph and Telephone Consultative Committee, the predecessor of ITU-T.

16 The European Computer Manufacturers Association, an industry consortium.

17 Accredited Standards Committee for Telecommunications - One, accredited by ANSI in the US.

18 European Workshop on Open Systems.

and, of course, the IETF. Likewise, user organisations like TERENA[19] have been established. Figure 2.1.2 depicts the expanded and far more complex universe of the 1990s (without any claim for completeness).

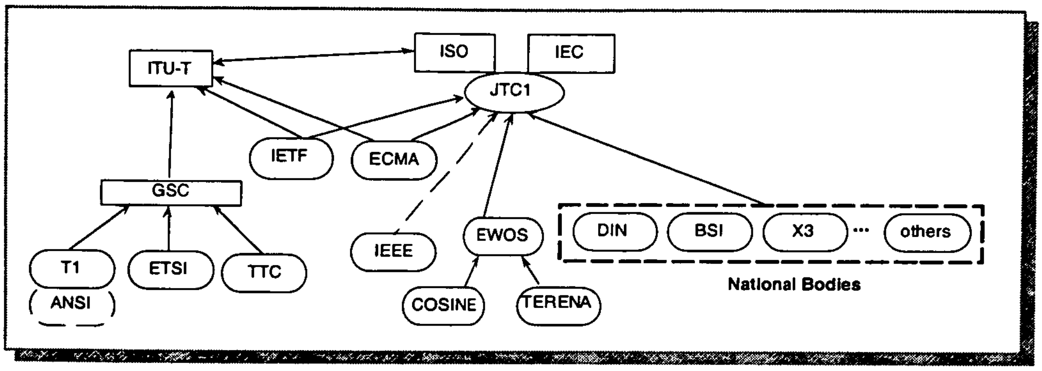

Figure 2.1.2: The IT Standardisation Universe in the 1990s

Whilst this broader community involved in the process of standardisation gives rise to the hope of more useful standards that can survive in the open market at the same time it potentially lowers the value of a specification as competing documents may be developed in parallel elsewhere [Besen 95].

2.1.1.3 A Model of the Standards Life Cycle

A rough sketch of the standards life cycle, which covers standardisation efforts, and follow-up activities like profiling and testing, is depicted in Figure 2.1.3. Similar cycle stages have been identified by other organisations as well (see [Carg 95]).

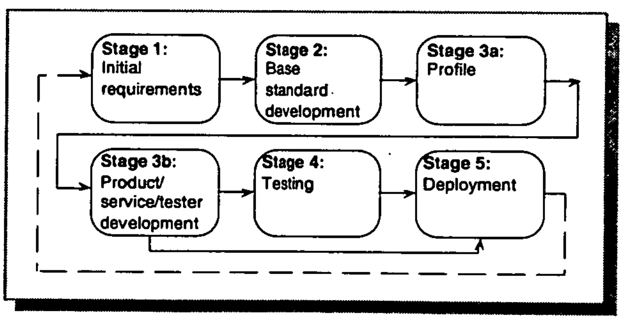

Figure 2.1.3: The Stages of the Standards Life Cycle (sketch)
(according to [Reil 94])

As can already be seen from this figure, actually developing and writing the base standard accounts for only part of the overall development cycle. To further refine this

[19] Trans-European Research and Education Networking Association.

model, to show who is doing what at which stage, and especially to include interdependencies, ANSI Accredited Standards Committee X3 developed a model summarised in Figure 2.1.4. Apparently this was the first attempt by an SDO to understand the full standards environment they are working in [X3 93].

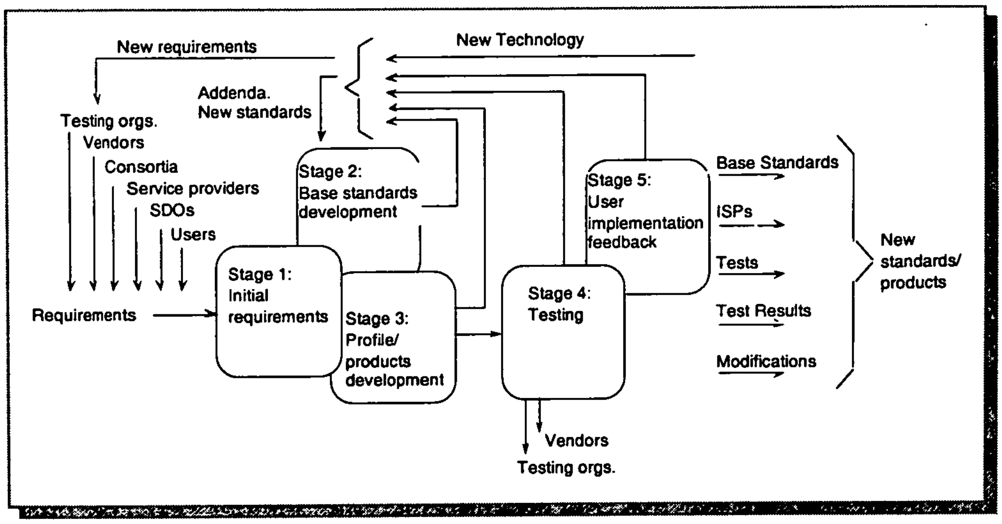

Figure 2.1.4: Summary of the Comprehensive Standards Life Cycle
(according to [X3 93])

Today, three years is the minimum period for standard production within ISO, which is roughly equivalent to stage two in the above model [ISO 95a]. Through the 'Fast Track Procedure', this period can be reduced to one year (this does not take into account development efforts that went into the specification prior to submission) [ISO 95b], [ISO 95c]. X3 states that nine months are *'the *optimum* timeline for approval of a specification that has behind it the full agreement of the technical community'* [X3 96]. Roughly another four years must be added to any of these time spans to cover the other stages as well.

The remainder of this thesis will primarily focus on the second stage of the life cycle, i.e. the development of base standards, with some additional emphasis also on the requirements compilation stage.

2.1.2 Policies and Economics in Standardisation

Standardisation may have far-reaching impact on companies and even on full grown economies. Placing money on a technology that eventually fails to become a standard, and to be adopted by the market, may well lead to the breakdown of a company. Pros and cons of joining the standardisation bandwagon vs trying to push a proprietary solution need to be considered. Standards based products or services may imply price wars and lower revenues, but may also open new markets and widen the customer base. Offering a proprietary solution may yield (or keep, rather) a loyal customer base, but may also result in a technological lock-in and, eventually, marginalisation for a vendor or service provider.

Assuming that standardisation is a desirable goal per se, and that it will take place anyway, the problem of how to select the 'right' standard, or how to standardise on the 'right' system, needs to be addressed. 'Right', of course, means different things to different people, which is why at least the non-technical dimensions of standardisation tend to be very tricky. Something that is 'right' for one country or one company may be disastrous for another. The international and possibly global scale of standards in the field of Information and Communication Technology (ICT) means that players with very different backgrounds from very different economies need to agree on something they deem to be at least more or less 'right'. For obvious reasons, some of which will be outlined below, those problems have been attracting considerable attention, especially against the background of the emerging Global Information Infrastructure (GII; see e.g. [OECD 91], [OTA 92], and [Kahin 95] for discussions).

The distinction between policy and economic issues may be somewhat artificial, as there exists a very close interrelation between them. After all, a company's policy largely serves to ensure its economic well-being. Still, there are differences, in that a policy covers broader ground than just economy, that should justify this separation.

The 'maze' of standards organisations [Salt 95] provides a fertile ground for very different types of standards and technical specifications (i.e. 'standards'). In the following, I will discuss stakeholders' motivations behind activities in the standards setting process, and some of the issues that need to be taken into account by those who seek to influence this process. Prior to that, however, let us first briefly examine why standardisation should be organised in the first place. After all, why not leave it all to the market?

Let us imagine what might happen if the market had to decide upon which technology to standardise. Several results are possible; one, of course, being that an optimal technology (or at least the best alternative available) actually wins. There is no need to discuss this case further. There are other possible outcomes, though. Consider, for example, a situation where different, but roughly equivalent technologies are available, none of which commands sufficient support to establish itself as the 'standard'. It may now well happen that this uncertainty paralyses the market, and that potential buyers postpone their purchases in order not to invest in a losing technology. As a consequence, innovation in that technical domain would come to a standstill. Clearly, nobody would benefit from a situation like this.

The notion of 'uncertainty' is important here. Standards are but a part of a larger socio-economic system, which does exert a certain amount of influence on standards' development[20]. That is, a standard is subject to path dependencies imposed on it by its broader environment. Unforeseen, and indeed unforeseeable developments may hamper all efforts and may even impose the need to start an activity all over again from scratch. Moreover, in most cases a standard is not a stand-alone document. Rather, it is positioned in a network of other standards (some of them possibly only emerging), which influence the boundary conditions within which it can emerge by laying down, for example, stringent compatibility requirements[21]. Last but not least, early decisions made during the standardisation of a technology itself may have significant impact of later decisions. Selecting the telephone network as the carrier for facsimile transmissions, for example, implicitly pre-defined numbering schemes to be used and possible transmission speeds [Schmi 92], as well as the need to eventually switch from analogue to digital transmission technology. More general, path dependencies were established at an early stage of the process, which to a considerable degree shaped subsequent developments.

It should now be obvious that no sufficiently accurate forecasts can realistically be made regarding future developments[22]. Whilst this uncertainty affects all predictions, it has a particular strong impact on standardisation. Here, big oaks from minor acorns grow. That is, comparably small events may carry great weight; in the absence of a sound basis for judgement and decisions the adoption of a particular technology by just one firm may encourage others to follow suit. If this happens, chances are that an inferior technology will be adopted, which may suit the initial adopter (who will have evaluated the alternatives and selected the technology to best suit his needs), but does not necessarily meet other entities' demands. They, in turn, will then make their

20 For a broader discussion on the potential mutual impacts between an environment and technology see sect. 2.2.

21 For a similar account see e.g. [Egye 97].

22 Cowan gives the example of the more recent need for new technologies to be environmentally sound, due to the environmental awareness that came virtually out of the blue. As one result, nuclear power has become less desirable in many parts of the world [Cowan 92].

choices solely based on the initial adopter's policy decisions. Little, if any experimentation with alternative technologies or systems will occur, which will rapidly be discarded. A similar effect may be observed when decisions to adopt are based only on initial expressions of a technology (e.g. implementations of IT systems). In such cases, a poor first implementation can easily reduce to zero this technology's chances of being adopted, since possibly superficial, implementation-specific shortcomings hide the technology's inherent advantages[23]. Likewise, observable early benefits of a technology will outweigh all other aspects; in particular, higher benefits to be gained from a different technology at some later stage will be ignored. Indeed, these benefits again cannot be identified at all due to the lack of opportunities for experimentation. It follows that the market can - and frequently will - adopt the 'wrong' technology when left on its own. 'Wrong', like 'right', of course is vague term; a technology may appear to be 'right' for a particular adopter, but at the same time the adoption may have negative impacts on others [Besen 95].

It is most likely that the above course of events could sooner or later be observed if standardisation were left to market forces alone[24]. To prevent this from happening, some form of coordinated standardisation efforts are required. (Prospective) standards surely try to reduce uncertainty by aligning players' views and expectations. Indeed, the pure existence of a standards setting process might suffice to prevent the development outlined above, as it would then be possible to raise expectations that a standard will soon be emerging from this process [David 95].

The desire to make sure that the 'right' standard emerges normally lies at the heart of firms' involvement in the standards setting process, be it in the 'official' process or in consortium-led activities. Yet, what exactly characterises the 'right', or at least a 'good' standard is far from being clear. Cowan associates a good standard with the attributes 'speed' and 'meet technical requirements' [Cowan 92]. Whilst these characteristics are valuable for winning stakeholders' support, this is a surprisingly narrow focus. Clearly any technical specification should meet technical demands[25], the

[23] For example, X.400 suffered from many inadequate early implementations.

[24] In fact, it does appear. The DOS operating system may be considered as an example: one strong player, IBM, chose this system, which did not really represent state-of-the-art at that time, and almost all others followed suit. Obviously, IBM gained significant profits from this development (as did, even more so, Microsoft). In fact, users benefitted as well, albeit not from superior technology, but solely from the emerging network externalities.

[25] For an account of what else may underlie a standards development see e.g. [Jak 96f].

issue of speed, however, is popular, yet questionable[26]. Moreover, meeting organisational and, particularly, societal requirements should clearly play a role in standards setting as well (see also sect. 2.2). Regrettably, though, trying to prevent standards from coming into being may also be a motivation for participation. In the following I will therefore look at the potential consequences of the different strategies firms are pursuing with respect to standards setting.

Standardisation is becoming all the more important with the increasing economic and corporate globalisation. At the same time, standardisation politics change. Strangely, national interests are becoming more important. A domestic standard successfully introduced into the global arena will not least boost the prospects of the domestic economy. Accordingly, governments now have a vested interest in pushing such standards to support domestic firms. These firms, in turn, will look to standards setting for several reasons which are typically, though not necessarily, related to their own economic well-being [Schmi 92]. Standardisation may thus to some degree be seen as an interface between technical and non-technical (e.g. economic, organisational or social) considerations[27]. That is, standards are not only rooted in technical deliberations, but also result from a process of social interactions between the stakeholders (particularly including governments and user/vendor companies). These dynamic interactions are projected onto the standardisation bodies' committees, where another dimension is added, that of the individual[28].

Schmidt and Werle [Schmi 92], for example, note that the common engineering background of most committee members will lead to a cooperative situation where all participants will work towards the 'best' technical solution[29]. Along a similar, yet more realistic line Cowan notes that once the basic choices have been made at a later stage of the process standardisation work becomes more cooperative, now very much

26 For a discussion of the desirability of speedy standards development see chapter 7.

27 The same holds for technological innovations. This will be discussed in detail in sect. 2.2.

28 For the impact of what has been termed 'standardisation ideology', i.e. the ideas on how standardisation should work, what it should achieve and why it is important etc, which are embedded in a standards setting body's structure and procedures, see [Egye 96].
The particular role of the individual in a standards committee will be discussed in detail in sect. 6.1.2.

29 This assessment may well be a bit over-simplistic. Whilst most committee members indeed have an engineering background, they do not necessarily solely strive for technical brilliance; if they do, there will be a real danger of over-engineered solutions. Yet, it all depends on the respective roles they are assuming. For a more realistic evaluation of the motives of the committee members see sect. 6.

resembling joint R&D efforts [Cowan 92]. Information is shared, and tasks are undertaken cooperatively. Resources dedicated by the different stakeholders, i.e. commitment demonstrated through their willingness to conduct quality research, prepare high-quality proposals, and take over responsibilities in the committee are important. Likewise, the technical, diplomatic and political capabilities of their representatives, and last but not least the roles they assume must not be underestimated, as they play a decisive role in the process (see e.g. [David 94], [Spr 95b]). These commitments and capabilities create asymmetries within the committees which may be exploited by a player.

Other gains may result from participation in standards setting than those purely associated with a successful proposal. Many committee members only participate for reasons related to intelligence gathering. For example, information regarding strategic moves of competitors or recent technical achievements may be gained, yielding a better evaluation of a company's position relative to its competitors. A recent survey showed that about fourteen per cent of committee members belong to that category [Spr 95b]. Moreover, a company's reputation may rise due to its commitment to standardisation, which (potential) customers may associate with a dedication to high quality.

Globalisation may have further impact on standards setting. Besen claims that market growth may well lower the need for compatibility, and that variety may be possible without a negative impact on market growth[30]. He goes on to argue that variety itself may be a source of growth [Besen 95]. This is a dangerous proposition, though. Pushing it only a small step further we will find companies introducing variety purely for (their own) growth's sake. Indeed, there is a likelihood that companies will follow strategies of deliberately introducing incompatibilities to tie customers to their systems [David 95]. If this happens, there will be an urgent need for other entities to counter such moves by backing alternative, compatible proposals. To add weight and credibility to this move, this alternative system could be introduced into the standardisation process.

If no compromise can be achieved when competing proposals exist, one possible outcome will be the formation of a new 'standards'-setting consortium established by one of the rival entities. This might also be an explanation for the alarming expansion of the number of 'standards' consortia (see also e.g. [Carg 95], [Rank 90]). A

30 However, this is not true if network externalities are high.

'Balkanisation' [Besen 95] of the standardisation process, with competing bodies developing competing specifications would be a potential result[31], which would further contribute to a deliberate introduction of incompatibilities.

Somewhat surprisingly, it has been argued that situations may exist where compatibility is neither practicable nor a socially desirable goal to achieve. 'Genuine uncertainty' regarding the best specification is offered as a justification for this proposition [Rich 97]. Yet, this immediately brings us back to the above discussion on 'uncertainty', and the potentially disastrous results that may be expected if 'standardisation' is left to the market (which would happen in case of uncertainty with no standard on the horizon).

Keeping to the issue of incompatibilities despite standards we note that interworking units (e.g. gateways) may contribute to lasting incompatibilities [Schmi 92], as they enable information exchange across, and maybe even interworking between heterogeneous (i.e. incompatible) systems, albeit typically with a loss of some functionality or information. Whilst good gateways may offer a higher level of compatibility, it must be noted that at the same time the better the gateways the more they serve to entrench incompatibility. Here, little motivation exists to go to great lengths to install an overall compatible, standards-based system since potential gains are comparably small thanks to good gateways. An almost comic touch is added to this situation when gateways themselves become subject of standardisation efforts.

Being active in standards setting is a costly business. It has been estimated that the costs for the development of an average IT standard amount to about $ 10,000,000 [Spr 96] - and that is only one standard. Another estimation says that development cost for a 'major international telecommunications standard' may amount to some 1,000 person-years of experience, twenty person-years of actual effort, plus $3 million [OTA 92]. JTC1 alone has been producing between forty and fifty standards per year over the last decade [Gibs 95].

Only fairly recently have economists addressed the problems associated with compatibility standards. In their terms major differences exist between standards in

[31] Although it is not always necessary to establish a new consortium to push a specification. As we could observe during the standardisation of Local Area Networks (LANs), it is well possible to standardise competing technologies within the same standards setting body. In the case of LANs Token Ring, Token Bus and Ethernet were standardised by IEEE and ISO.

ICT (or, more generally speaking, in fields where networking effects occur, as also e.g. railroads), and those valid in the 'rest of the world' (i.e. primarily where no networking effects can be observed). For the latter, the assumption of 'decreasing returns' holds [Farr 90], that is, benefits derived from producing something decrease with the number of people producing something similar. For instance, the revenues of the sole producer of washing machines may decrease once other companies start offering similar machines. In contrast, increased returns on adoption must be assumed for ICT; the value of an electronic mail service, for instance, will increase potentially manyfold with the number of users with whom communication links can be established. The arrival of competitors offering a compatible service will therefore not necessarily result in lower revenues, it may have the opposite effect and contribute to increasing profits due to the bigger market and the resulting increased value of the first system. Thus, given the increasing returns that stem from the global networks of today, ICT clearly has a major strategic implication, as has the underlying standardisation upon the outcome of which products will be based. Thus, the choice of a standard will have significant impact on the emergence of new technologies, the performance of single companies, and it may affect competitive advantages of whole economies [OECD 91]. Standardisation may therefore be considered by some as a useful vehicle to bring a company or a country in a more favourable position in the market by trying to push proprietary or national standards at the international or global level. Yet, with the dramatic increase of players and would-be players in the field of standardisation it remains to seen whether the respective values of the single, and sometimes competing, specifications live up to the expectations.

A company trying to push a proprietary solution towards the status of an international standard is probably the foremost association one has when thinking about the economic dimension of standards and standardisation. Significant increases in market shares - and thus potential gains - may be at stake when a product stands to be ennobled by becoming a standard. At the same time this is the ground upon which turf wars within the committees flourish if competitors try to either push their own ideas, propose a 'neutral' solution, or just try to impede the whole process in order to prevent any standard in the field in question. According to [Besen 95] four distinct situations are possible:

- **Common interests**
  There are no competing proposals, and a decision can quickly be reached by consensus. All parties involved attempt to serve the common good.

- **Opposed interests**
  Each opponent prefers his own proposal to be adopted, but would prefer no standard at all to the adoption of a competitor's proposal. This situation arises when the gains associated with the winning proposal are comparably big compared to the gains of the industry as a whole.

- **Overlapping interests**
  Again, each opponent prefers his own proposal to be adopted, but would rather have a competitor's proposal adopted than have no standard at all. This may happen if, conversely to the situation outlined above, the whole industry stands to benefit the most from the adoption of a standard (regardless from where it originated) rather than the original proposer.

- **Destructive interest**
  At least one player prefers not to have any openly available standard at all, and accordingly tries to slow down the process. This player typically is a major vendor largely dominating the market with a proprietary product who would lose market shares if a standard were in place.

Obviously, these alternatives all come down to the question of competition vs cooperation. The path towards competition may eventually lead to a company's dominating market position with a product or service based on their own proprietary specification. Yet, at the same time the virtual absence of other players may render this particular market insignificant[32]. On the other hand, cooperation establishes a broader market for products or services based on open specifications, created through, and capable of accommodating, a number of different players. As has for instance been shown in [Swann 90], a product that succeeds in creating an environment in which other vendors consider it beneficial to produce compatible products will prove considerably more successful than its competitors. Such compatible products can only emerge if the underlying original specifications have been made public, or if a very liberal licensing policy has been pursued. This example serves to highlight potential benefits to be gained from open specifications, even if the product itself is inferior to its (less open) rivals in terms of functionality provided. Here, the range of products compatible to the original specification strengthen its status as a de-facto 'standard',

[32] Basically, this happened to Apple Computers Inc., who implemented a very restrictive licensing policy and as a result eventually lost the battle against Microsoft and were left stranded with a rapidly diminishing market.

which in turn triggers the development of even more compliant products [Swann 90]. As a result, a bigger market has been established, leading to increasing revenues.

Another popular (and to some degree valid) perception has it that standards, once established, tend to suppress the development of superior technology. This is true, however, only if 'superior' at the same times means 'incompatible' [Gab 90], which is not necessarily, though often, the case. Customers waiting for the advent of ATM[33] systems, for instance, severely hampered and, in fact, virtually thwarted the take-off of another, earlier high-speed communication system, DQDB. In the same way, an established standard may not only hinder progress, but also reduce the variety of alternative technologies. After all, that is what compatibility standards are all about. The resulting limited variety of technological options carries the risk of being left with a less-than-optimal solution, which in turn may eventually yield the need for an expensive move towards a better, but incompatible system. At the same time, however, because of its dominant position in the market the winning standard-based system may trigger follow-up developments. For example, a wealth of different applications were soon available once the PC and DOS had established themselves as (de-facto) standards. This example also illustrates another potential economic effect of standardisation: increased price competition. As functionality or other product characteristics have been eliminated as means of competition, prices become even more important. This development will most likely result in price cuts which will, in turn, push the diffusion of the system. It does not really matter here if the standard in question has evolved through sheer market power as a de-facto standard, originated from an industry consortium, or proceeded through 'official' standardisation processes (e.g. ISO, ITU, or IETF).

Against this background it is no big surprise that, at least initially, the major players in the ICT field were very reluctant when it came to open standardisation. With large customer bases for their proprietary systems they had little incentive to open up this lucrative market to competitors; IBM in the sixties and seventies being a case in point [Adams 82]. Such dominant companies, who control the market, or at least major segments of it, have to lose the most from openly available standards. More recently, however, even major players seem to realise that their products hardly stand a chance of dominating an ever growing and increasingly competitive market. Strategic alliances

[33] Asynchronous Transfer Mode, a cell-based high-speed communication system, upon which Broadband-ISDN is based. ATM emerged in the late eighties, and its standardisation is still (early 1997) far from being finalised.

are formed with producers of complementary products, users, and competitors. Even arch-enemies (e.g. Netscape and Microsoft) have agreed to cooperate in certain areas to enable the development of de-facto 'standards'[34]. Ultimately, the desire to open up markets has in many cases led to the formation of consortia, the major, and maybe only, goal of which being the establishment of open specifications, which may eventually be submitted to one of the 'official' standards setting bodies for formal approval.

Thus far, the discussion has been somewhat focussed on the vendor's views on standardisation. Obviously, things look slightly different from the user's perspective. For them, standards serve three major purposes:

- **Avoid technological dead-ends**
  Users want to avoid purchasing products that eventually leave them stranded with an incompatible technology. A number of issues need to be considered in this context. For instance, it has to be decided if and when a new technology should be purchased, and which one should be selected. Too early adoptions not only bear the risk of adopting a technology that eventually fails in being successful in the market, but also ignore the considerable time and money that have gone into the old technology. It has to be decided if and when to switch from a well-established technology to a new one. Investments in the old technology need to be balanced with the prospective benefits potentially to be gained from this move. On the other hand, late adopters may lose competitive advantage while being stuck with outdated technology.

- **Reduce dependency on vendors**
  Being locked in into a vendor-specific environment is increasingly becoming a major risk for a user, despite the advantages that can be associated with integrated proprietary solutions. In particular, problems occur if a vendor misses an emerging development, and its users are forced to switch to completely new (and different) systems; a very costly exercise [Ferné 95]. Accordingly, standard compliant products from a choice of vendors appeal to the users, who can pursue a pick-and-mix purchasing strategy, and also stand to benefit from price cuts as a result of increased competition.

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[34] As happened in the case of Netscape's Open Profiling Standard (OPS, see [CZ 97b]).

- **Promote universality**

  Ultimately, users would like to see seamless interoperability between all hardware and software, both internally (between different departments and sites) and externally (with customers and business partners). With the ongoing globalisation of markets this can only be achieved through international standards. Clearly, this holds especially for communications products. Ideally it should not matter at all which vendor or service provider has been selected; interoperability should always be guaranteed. This implies that user needs and requirements are met by the standards (and the implementations). In addition to seamless communication - and the business value that lies herein alone - there is another major economic benefit to be gained: the costs of incompatibility may be tremendous. For instance, in 1980 half of General Motor's automation budget went into the design of specific interfaces between incompatible machines [Foray 95], a situation that would not have occurred if adequate standards had been available in the first place.

An issue closely related to the above is the timing of standards. A typical complaint about today's 'official' standards setting processes,has it that standards emerge too late, that they are overtaken by the technological development, especially in the realm of IT (see e.g. [Carg 95], [Bucc 95]), and that accordingly new ways of producing standards need to be found. Whilst it is certainly true that a standard needs to meet its window of opportunity, it is equally true that a specification done hastily bears the risk of producing a technological lock-in, i.e. to standardise on an inferior specification. This may easily happen since the long-term values of a proposed standard are difficult to evaluate, potentially giving advantage to proposals with well understood short-term benefits[35]. Thus, a lengthy process may well make sense in the long term.

Funding - or rather the lack of it - is another aspect which is of particular importance to the user community. In fact, it is one of the most prominent explanations for users' abstention from standardisation. Active involvement in standardisation not only demands regular participation in meetings; additional time for preparation is also required. A standard worker will not be available to his/her employer for a considerable length of time if the engagement is taken seriously, incurring major expenses. Various suggestions have been made if and how funding should be

[35] This bears an uncanny resemblance to what might happen if standardisation were left to the market alone (see above). Long-term benefits are sacrificed for the sake of short-term profits.

provided to attract more users. Views differ widely in this respect; Rankine claims that no special funding needs to be made available to users because users already are adequately represented on the committees [Rank 95], whereas it is argued for instance in [Fisch 90] that additional funding should be made available by interested parties (e.g. governments) to enable and promote participation of smaller users.

This discussion on the economic importance of standards induces the question how to guarantee, to the greatest possible extent - that standards setting activities yield a result that is widely adopted and can survive on the market.

2.1.3 How to Design the Standardisation Process

Developing a standard is not an end in itself. The yardstick for a standard's success or failure is its acceptance in the market. That is, users must feel that they will benefit from employing products and services based on, or incorporating, this standard. It follows that its origin (proprietary, consortium, standards body) may be of less importance to the user. In fact, it has been noted that wide distribution of a standard is more significant for many than even its technical quality [Upde 95b]. This leads to the question what exactly establishes a 'successful' standard. Crucial attributes of an ideal standard have been identified in [Upde 95b]:

- high technical quality,
- effective solution to the initial problem,
- timeliness,
- wide adoption.

It would seem from the above that the last point is the most important one. The other criteria should not be ignored, though, as they may also contribute significantly to actual adoption. However, it might be argued that 'high technical quality' and 'wide adoption' are almost mutually exclusive, as the latter will almost always be based on compromises, which, in turn, stand in the way of the former. Alternatively, inclusion of options has become a popular way of accommodating the desires of different players.

It is easily conceivable that no single factor exists to guarantee a successful outcome of a standards setting activity. Rather, we can observe a complex interplay of different contributors; the most important ones have been identified in [Isaak 95]. A standardisation process must

- be driven by a commitment to business value,
- engage interested parties,
- be based on real requirements,
- have vendor implementation commitment,
- establish confidence in conformance,
- reflect due process,
- attract a critical mass of purchasing power,
- recognise IPRs.

It may be concluded that the economic considerations regarding the respective value of open vs proprietary systems likewise hold for a company's decision whether or not to participate in standards setting. Here, the situation is virtually identical for users and vendors alike; although the respective motivations will be different (see above). A standard's success - in terms of market penetration - will first and foremost depend on its appeal to a sufficiently large number of users[36]. Consequently, the major task has to be to assure the broadest support possible[37]. As users will have to be assured that the standard to be developed will actually be the way forward, broad vendor support of the activity will also be essential. This holds especially if there is the danger of a dominant player coming up with a competing product based on proprietary specifications. Yet, it would in most cases take a very strong player indeed to compete with a strong alliance of competitors.

From the business process point of view, standardisation these days is an extremely simple procedure: a perceived need is identified somehow within (or possibly outside) a standards setting body; if a specified number of members subscribe to this view and offer support and commitment a work group or committee is established to provide a technical solution to the problem in question. All standards setting bodies have well-defined rules in place to guide committees from deliverable to deliverable until eventually the proposal is ready for voting, which is again governed by a set of precisely defined procedures. However, very little is available in terms of guidelines for the management of the actual work in the committees, and no policies exist within ISO, ITU or IETF to prevent a committee from being dominated by an interested party or group. In an era of multinational companies ISO's 'one country, one vote' balloting

36 This is clearly true for standards for networked products; large numbers of users are less important for quality or unit standards.

37 Given the increasing internationalisation of both markets and standardisation activities, worldwide support should be sought.

approach, for example, seems ill suited; it should not be too difficult for a sufficiently interested multinational to dominate balloting through company representatives on the single national committees, or through 'proxies', who exist in the form of standards consultants[38].

Moreover, nothing is being done to establish whether or not the perceived need actually justifies the effort. Given that the costs associated with OSI, for example, have been estimated at over $4 billion [Fernė 95] standards setting bodies would seem to be well advised to produce a business case prior to the technical work ([More 96], see Figure 2.1.5). A major task therefore is to sell the planned activity to those who would actually have to carry most of the financial burden, and who may be expected to be most interested in the final product, including particularly vendors and users. It is them who need to be convinced of the benefits to be gained from the proposed standard setting activity, and that it is in their best interest to participate and commit resources to it. Issues to be addressed here include requirements compilation and verification, ability to meet these requirements, identification of resources required, expected stability of the standard, likelihood of meeting a window of opportunity, establishment of appropriate liaisons, etc.

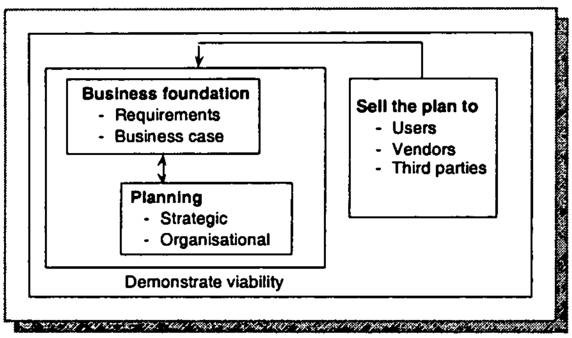

Figure 2.1.5: Establishing a Standards Activity (adapted from [More 96])

To come up with a meaningful set of requirements, however, implies that users actually know to what use the proposed new standard will be put within their respective organisation. This, in turn, implies that corporate strategists are also needed to be engaged at least during this stage, in addition to the engineers who typically populate standards committees [Spr 95b]. Likewise, users from different types of

38 Within ITU, only Members, i.e. states, typically represented by their national PTTs or equivalent organisations, have the right to vote [ITU 93a]. Only individuals, not institutional representatives, participate in the IETF [RFC 96a].

companies (including particularly SMEs[39], as opposed to large organisations), and from different backgrounds have to contribute. Only if users can be assured that their needs and requirements will establish the basis of the proposed standard can their commitment to eventually purchase products based on this standard be secured. In parallel, commitment from vendors to actually implement the standard needs to be obtained. If these prerequisites can be met it will also imply that the need for functional standards and profiles vanishes, which in turn speeds up the overall process, thus reducing the time to market.

Following these 'preliminary' activities, the standards development can commence. In addition to the technical work of actually specifying the standard this process also comprises market development activities. That is, users need to contribute their - potentially changing - exploitation plans, the windows of opportunity have to be considered, and market awareness needs to be established. Related activities include early demonstrators, which will also serve to increase confidence of both, vendors and users, in the standard. This whole development process has to be managed effectively, strict scheduling has to be enforced through milestones, checkpoints and deliverables. Moreover, personnel whose job descriptions explicitly include standards development (as opposed to the rather more 'voluntary' workers today) need to be made available. Even if all this has been considered two more issues need to be resolved: how to assure that all stakeholders have an equal say during the process, and where to locate this process (i.e. whether to have a consortium or an official body do the work).

The issue of 'due process' is of such importance that it has to be discussed on its own. Due process and consensus are widely considered as the fundamental cornerstones of any 'official' standardisation process (and may be observed to a slightly lesser degree in consortia, see e.g. [Bach 95], [Hawk 95c], [OTA92], and are completely absent in the case of a proprietary standard). The former is originally a legal term; the underlying concept was designed to limit arbitrary use of power by some (governing) entity. The latter is achieved when substantial agreement has been reached by all participants. This signifies more than a simple majority, but not necessarily unanimity. When applied to the standards setting process, due process means "*... that any person (organisation, company, government agency, individual, etc.) with a direct and material interest has the right to participate by a) expressing a position and its basis, b) having that position considered, and c) appealing if adversely affected.*" [ANSI 95b].

39 Small to Medium Enterprises.

This implies, among other things, advance notice of meetings and timely distribution of all related documents, the equal right to speak for all interested parties, strict rules on balloting procedures, availability and accessibility of an appeal body for those who feel have they suffered from improper actions, and parliamentary courtesy between committee members [Gray 95]. In summary, due process guarantees that everyone who might potentially be affected by a standard has the right to participate in the process on equal terms. It is a basic requirement for the development of consensus which in turn requires that all views and objections be considered, and that an effort be made towards their resolution. In an official standards setting body, for example, this effort is required at two stages. Firstly, members of the technical committee have to agree upon a specific solution, and secondly consensus of the members needs to be achieved during balloting. Due process and consensus have been identified above as being important, and they are indeed indispensable if a sufficiently high level of trust is to be established into a standards setting procedure. However, achieving consensus, both among the single members of a technical group and among the high-level entities that take the ultimate decision on a proposed standard (e.g. the national bodies in ISO) takes time, which may in turn lead to a lost window of opportunity. In fact, consensus is at the same time the strength and the weakness of the official bodies. Several measures have been embraced by the official standardisation bodies aiming at a reduction of the time span for balloting, and possibly for building consensus as well:

- Better utilisation of various electronic communication media [Mazza 95].
- Implementation of management strategies to guide the projects [ISO 96b].
- Re-design balloting procedures [Karp 93].
- Mechanisms to integrate proprietary specifications into the process ([ISO 95d]).

Indeed, consortia which exhibit a more relaxed attitude towards strict due process and consensus, and which have far less stringent and time consuming balloting procedures appear to have an advantage here; they can move faster. For instance, more dedicated personnel (and employers) will be readily available, thanks to the well defined common (business) goal, and the underlying understanding that this goal cannot be reached by any one member alone [Upde 95a]. Compared to this situation the measures proposed by the 'official' bodies outlined above appear to do little else than fiddling about with the symptoms rather than offering a cure.

It remains to be seen, however, whether the process of consensus building actually needs to be reconsidered. After all, while preventing rapid development of standards, consensus offers a quality potentially much more valuable than speed: longevity. Any standard that has gone through the painstaking procedure of consensus building, during which (ideally) all concerns have been considered, eliminated or, if deemed necessary, integrated stands a far better chance of surviving for a reasonably long period of time than does a consortium specification. As often as not the output of a consortium tends to reflect the views of an individual company, possibly this consortium's major sponsor [Upde 95b], who may have invested heavily in the consortium and is looking for some return on investment. First and foremost, this is a potential result of the less stringent commitment to observe due process. Likewise, a consortium's speed in producing a specification may not least be attributed to the highly motivated, full-time personnel made available by the stakeholders. Yet, there is a potentially high price to be paid: first, this personnel will try and push their employer's ideas. Second, the need of providing personnel will exclude smaller companies from joining the consortium and will, at least potentially, make them stay clear of the standards.

Judging by the list of requirements on the standardisation process listed above, and taking into account the arguments presented, it would seem that a combination of a consortium-style process (because of its speed), followed by the official sanctioning of its - potentially modified - outcome (to preserve the public good character of a standard) could combine the best of both worlds [More 96].

2.1.4 Pros and Cons of User Participation

Discussions of the issues surrounding the problem of user participation in standards setting have long been high on the agenda of both, researchers and the standards setting bodies themselves. There is a general agreement that user participation is a sine qua non for a standardisation activity to be successful, particularly in the field of information technology (see e.g. [Bogod 90], [ETSI 92], [Fisch 90], [Hanra 95], [ISO 96b]). In fact, increased user participation is often considered as the panacea for all problems[40]. However, very limited numbers of user representatives can be observed in almost all major international standards organisations. Looking at the list of ITU-T members, for example, reveals the virtually complete absence of users; by

[40] There is a strange exception, though. [ISO 90b] states that negotiations in the case of emerging technologies (i.e. for anticipatory standards) *"... do not need to be conducted under the traditional multi-interest consensus procedures..."*. This holds because *"... an emerging technology has no users yet"*. In effect this means that users may be excluded from the specification of anticipatory standards.

definition, government members (i.e. those with the right to vote) represent their respective governments and typically are the national PTTs or equivalent organisations. Among the private sector members there is an almost one hundred per cent dominance of vendors and manufacturers. Within ETSI, the list of full user members comprises twenty-seven names, only about half of which, however, really are users[41]. Moreover, as has been observed in [Naem 95], user members, even those who actually deserve this description, do not always contribute, and most users are not members anyway.

Another issue to be considered concerns the different types of users that may be identified. The different categories of users will be discussed in detail in sect. 2.3. However, a further distinction has to be made between large corporations and smaller ones - SMEs - as they differ considerably in terms of IT and communication requirements, available resources and knowledge [Ferné 95]. Moreover, it has frequently been observed that SMEs do not normally participate in standardisation, a fact typically attributed to a lack of resources [OECD 91]. It follows that measures have to be taken to enable smaller companies to contribute to the process as well. This is all the more important since SMEs are a major cornerstone of employment, and of increasing economical importance in the future [OECD 95a], [OECD 96a].

If users participate at all in standards setting, they will do so with motivations very different from those of vendors and service providers, who seek to protect their own business interests by either trying to push proprietary solutions or by joining the 'open systems'[42] bandwagon, whatever is deemed most profitable. Above all, though, they want to keep - better yet, increase - their customer base. Users, in turn, will primarily try and push their specific requirements during the process. While typically wishing to have standards-based systems, users at the same time also want to have solutions which are adaptable as much as possible to their specific needs. Thus, clashes are pre-programmed not only between single vendors, but also between vendors and users. Not least in an attempt to circumvent these clashes, and to accommodate their customers, vendors tend to incorporate enhancements into their products to meet actual demand (see also sect. 5.1). Similarly, every now and then users tend to design their own standards, which then eventually compete with their official counterparts. This

41 SITA, for example, are a major global network provider, and RWE are hoping to become a new big player in the emerging liberalised German telecommunications market; both hardly qualify as 'users'.

42 For an account of what exactly 'open system' may mean see e.g. [Carg 94].

happened for example in the case of EDI, where the official standard (EDIFACT) was preceded by, and has to compete with, several sector standards. Ultimately, such activities are likely to undermine the general idea of compatibility standards.

The above thoughts unveil a number of questions directly related to the issue of user participation in standardisation[43] - why, what, how, where, and when to participate (see also [Ferné 95], [Salt 93]). First, why participate at all? After all, such commitment implies major expenses on the part of the user, with a very uncertain return on investment (see also sect. 5.1). Yet, users need to recognise that they are the ultimate sponsors of standardisation (the costs of which are included in product prices, [Naem 95]). Indeed, as customers they have a tremendous hold over the industry. This holds especially in telecommunications, where the benefits to be gained from network externalities[44] will either rapidly attract more and more users, or where their absence will throw a standard into obscurity (see e.g. [OECD 91]). Moreover, users will suffer most from inadequate standards, that will leave them struggling with incompatibilities [Foray 95]. Likewise, they will benefit from well-designed standards addressing real needs; for one, they stand to gain major benefits from backward-compatible standards, which offer a degree of protection against obsolescence.

What could users contribute? Two prominent areas may be identified, the most obvious one being their needs and requirements. It has been pointed out in [Isaak 95], for instance, that user requirements are rarely, if ever, specified in a way that renders further discussions, refinements and elaborations in the committees dispensable. Moreover, users do not see standards as a means in itself; rather, they need systems that work smoothly in networked environments, that can easily be interconnected and are interoperable across both, network and organisational boundaries. Their choices will therefore be pragmatic, and standards are only one way to achieve these goals, albeit a very obvious and convenient one. This needs to be accepted by standards bodies if they want to produce standards which stand a chance of survival in the market place. As a consequence, these bodies must realise that only business users can provide this crucial input [Alex 95]. Taking these thoughts one step further, users need to ensure that not only their compatibility needs be addressed, but also their overall 'computing' needs [Carg 95], i.e. those requirements that originate from their

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43 The term 'user' denotes corporate users, as opposed to individual end-users.

44 The existence of network externalities means that the value of a product increases with the number of its users.

organisational and strategic environments. As has been mentioned above, it follows that users should preferably be represented by corporate strategists and managers during this initial stage, rather than engineers.

The second area is somewhat similar. Users will go through a learning process when employing services. At some stage, therefore, they will be able to contribute their experiences gained from real-life day-to-day work to the process [Foray 95], [Salt 93]. These experiences may eventually bring users in a position to work actively on the technical committees, and make contributions well beyond pure requirements compilations [Naem 95]. At this point, however, opinions vary. Whilst Ferné subscribes to the view that users are well able to contribute to the technical work [Ferné 95], Alexander, for instance, maintains that the technical nuts and bolts should be left to the vendors [Alex 95]. This discussion will be taken up again later in the light of further findings (see sect. 6.3 and chapter 7).

Having accepted the notion that contribution to standardisation is in the users' own interest, the next issue to be considered is 'how to participate'. Whereas the 'why' has been addressed at length in the literature, this question remains somewhat less touched. Rather vague suggestions that mechanisms are required to enable users to express their needs, and to contribute their resources to standards setting, have been made in e.g. [Bogod 90]. However, few concrete recommendations as to how exactly this could be done are provided. In general, though, there seems to be consensus that large users, especially those with an urgent need for standardised systems or services should (and do) participate directly in the technical work (see e.g. [Salt 96]). However, especially for smaller companies there are obvious barriers to this form of participation, rooted in the lack of sufficient financial resources and knowledgeable personnel. Naemura suggests that smaller users should participate through trade associations [Naem 95]. Likewise, a similar, popular suggestion to overcome these barriers is the formation of 'user coalitions' [Foray 95], i.e. users have to organise themselves so they can play an appropriate role in the process [OECD 96a].

It has been pointed out above that the standards setting process comprises a variety of different types of organisations, commonly and collectively referred to as 'standards setting bodies'. These include official voluntary organisations such as ITU and ISO, organisations dedicated to the specification of functional standards like EWOS[45] as

45 The European Workshop for Open Systems.

well as industry consortia like X/Open or the Object Management Group (OMG). Thus, 'Where to participate?' is another question to be addressed. It may be said that in most cases 'the standardisation process' is looked at as something akin to an atomic entity, which cannot be subdivided any further (as e.g. in [Dank 92] and [Cowan 92]). In particular, rarely is a distinction being made between organisations producing base standards and those in charge of functional standards. In a notable exception, Ferné distinguishes between user participation at national/international level, in product/functional standardisation, and in reactive/proactive activities [Ferné 95]. However, whilst providing some examples that might attract greater user interest and thus participation, it is not clear where participation is most beneficial for users. Participation in profile development would be the option of choice if interoperability of implementations were to be assured. On the other hand, there is little point in specifying a profile for a base standard that does not meet the requirements.

Finally, when should users participate? This problem is closely related to the question of what users can contribute to standardisation. The two genuine user domains, requirements and operating experience, seem to suggest that the crucial periods of user contributions are prior to, or at a very early stage of, a standards activity (requirements), and either following field trials - which may or may not be part of the process - or after the project has finished and products are available on the market (experience; see also [More 96], where field trials are seen as an integral part of the standardisation process). Whilst these suggestions appear to be straightforward, they too will need additional discussion, which will be postponed until the final chapter.

2.1.5 Learning from Other Disciplines?

Several associations may come to mind when trying to characterise the standards setting process, including for instance 'distributed', 'design', 'specification', and 'cooperation'. Other disciplines or research areas share at least some of these attributes; one that comes to mind fairly quickly is 'software engineering'; 'business studies' being the other, possibly less obvious one. It may be worthwhile to have a very brief look to find out if potentially useful similarities unfold.

2.1.5.1 Software Engineering and Usability

According to [Jalo 91], *"... software engineering is the discipline that provides methods to handle this complexity* [of the development of large software systems], *enabling us to produce large software systems with maximum productivity."* If we replace the term 'software system' with 'standards specification' the similarity between the general scope of software engineering and standards setting becomes fairly obvious. An average IT-standard definitely qualifies as a complex system, and it does not matter that much whether this system is to be specified in a programming language or in plain text in the first place. Thus, a brief closer look at some basics of software engineering should be in order.

The waterfall model is an early model of a software production process, but is still frequently used (see e.g. [Ghezz 91], [Hawr 95], [Jalo 91]). It describes the process as a linear sequence of, potentially overlapping, steps from a feasibility study to maintenance of the final system. However, this model does not deal adequately with a number of issues. For one, the requirements need to be defined at a very early stage, and no mechanisms are provided for further requirements elicitation during the course of development. This is acceptable for products developed for general marketing, but additional mechanisms need to be included if new and refined requirements are likely to occur over time. To overcome this limitation an extended waterfall model has been defined, the linear cyclic model (Figure 2.1.6; see e.g. [Hawr 95]).

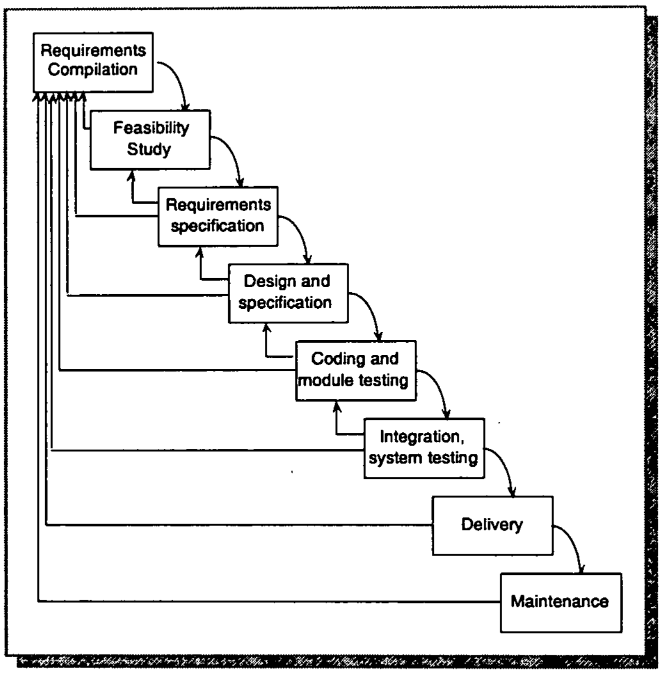

Figure 2.1.6: The Linear Cyclic Model

The similarities between the single phases of this model and the ones of the standards life cycle are evident, suggesting that lessons may indeed be learned by standards organisations from the software engineering community on how to develop a specification. In fact, these models are so similar that it may be concluded that standardisation is a - maybe particular - form of software engineering (see Figure 2.1.7). From this it follows that the 'technical' bit of standards setting, i.e. the work in the technical committees aiming to actually specify the standard is some form of design activity.

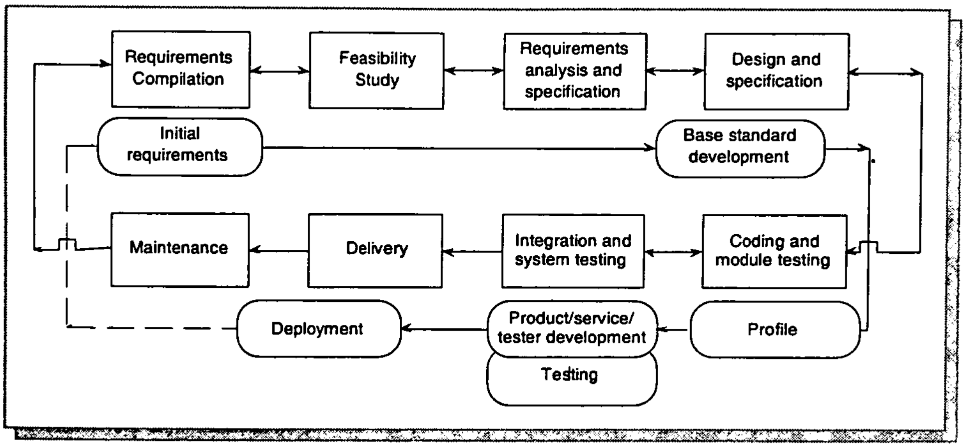

Figure 2.1.7: The Linear Cyclic Model in Relation to the Standards Life Cycle

However, attention must be drawn to the differences in the two models, which lie basically in the modules 'Feasibility study' and 'Maintenance'. The former is particularly interesting as it is completely missing from the current standardisation processes, where the equivalent would be something like the development of a business case for a proposed activity. 'Maintenance' provides a formal feedback mechanism for users into the standards setting process which is also currently not available.

Another model that has recently become very popular in software engineering is the spiral model (Figure 2.1.8, see also [Boehm 88]). Its goal is to provide a framework for process design guided by risk levels; accordingly, it provides a view of the process that supports risk management[46]. The model focuses on the identification of high-level risks and their appropriate treatment. The dynamic model of the implementation process (which is discussed in detail in sect. 2.2) represents an adapted expression of the spiral model.

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46 'Risks' are circumstances that may have negative effects on the development process and may impair the quality of the product [Ghezz 91].
'Risk management' can be defined as a *"discipline whose objectives are to identify, address and eliminate software risk items before they become either threats to successful software operation or a major source of expensive software rework."* ([Boehm 89], quoted in [Ghezz 91]).

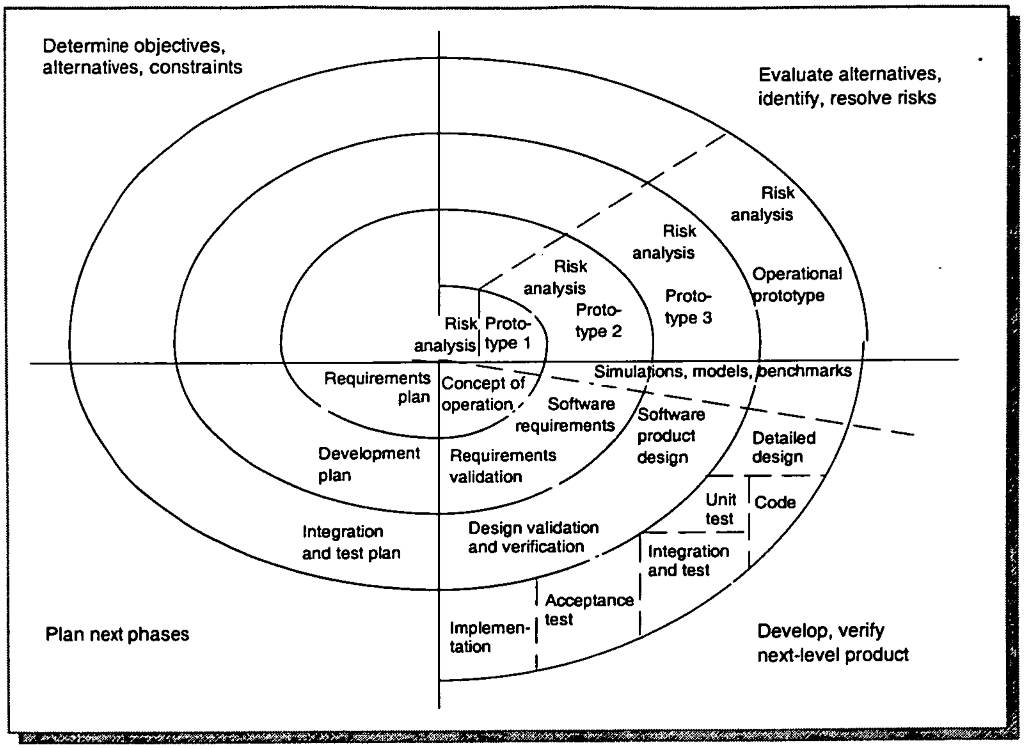

Figure 2.1.8: The Spiral Model

The usability discipline offers a different approach to design. It aims to create a socio-technical system, as opposed to the purely technical approaches outlined above. That is, this approach reflects that implementing an IT system helps create a different organisational environment. As a consequence, the design and development process needs to shift its focus towards the user and his work environment. This implies an increase in the importance of the user's role in the design process (see Figure 2.1.9).

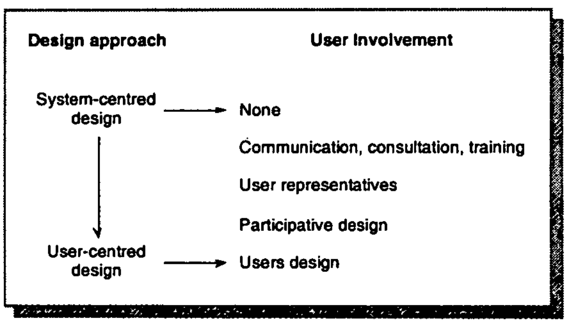

Figure 2.1.9: Different Degrees of User Involvement in the Design Process

One straightforward method to achieve meaningful user participation and input during system design would be to proceed as suggested in Figure 2.1.10 below, that is, to employ an iterative design process using prototypes [Booth 92]. During this process users can refine and, if necessary, re-define the system.

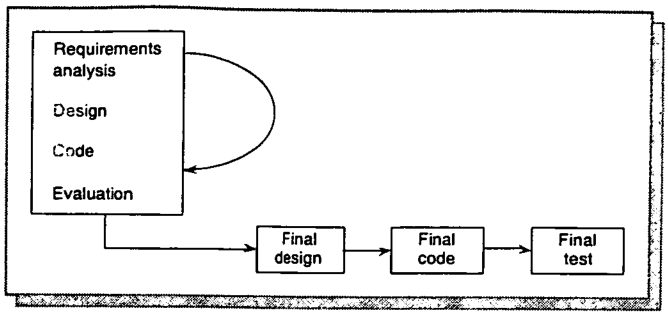

Figure 2.1.10: The Prototyping Model

The one argument typically found against this approach is related to time and money. It is argued that designers have neither the time to do prototyping, nor can the additional time be afforded (see e.g. [Bello 88]). However, as e.g. Nielsen argues in [Niels 94], this is not necessarily the case, depending on how usability engineering is done. Moreover, as noted in [Lind 94b], failing to meet usability requirements may be far more costly than even extensive usability testing. And finally, if usability flaws are detected only during a late stage of a project, integrating the additional code required may ruin an otherwise clear and elegant design.

In addition to the prototyping method usability may also offer guidelines in another area: the adoption of technology. Figure 2.1.11 depicts a (somewhat idealised) approach of how new information technology can be adopted to support the existing organisational and work environment.

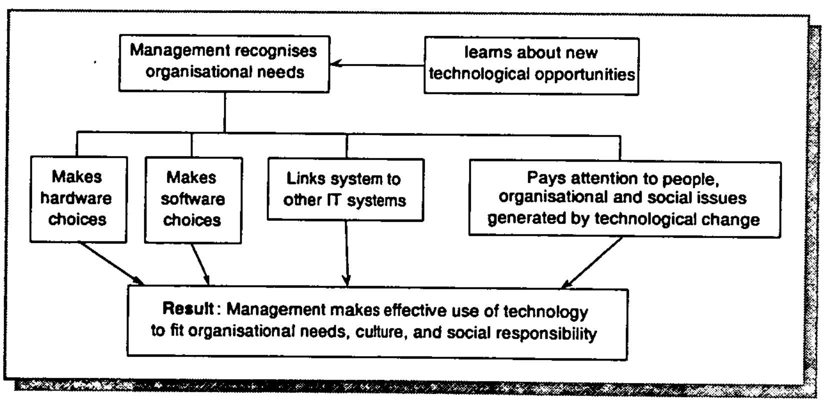

Figure 2.1.11: Developing Systems to Fit into a Given Environment
(according to [West 85], quoted in [Booth 92])

This approach basically comprises of a top-down initiated adoption. Aspects to be taken into account include strategic planning, the 'ownership' of the new system, employee involvement throughout the course of the project, provision of open communication channels between management and employees, as well as issues such as potential impact on job design, ergonomics, and the regulatory environment. Unfortunately, according to [Clegg 96], issues related to usability in general and the involvement of end-users in the design process in particular are still poorly understood within organisations. For a discussion of the lessons that might be learned by the standardisation community from software engineering and usability see chapter 7.

2.1.5.2 Participatory Design

The above brief discussion of the usability discipline already pointed at the importance of strong user participation in design, in order to achieve a usable and useful system. Indeed, user involvement in the design process has long been seen as axiomatic in the information systems community [Carm 93]. A number of different approaches have emerged, out of which Participatory Design (PD) has attracted a good deal of attention over the last couple of years.

One of the most important distinction between different user involvement methodologies lies in the degree to which users participate in an emerging design. Obviously, this has an impact on the influence exercised by users, and thus ultimately on their degree of satisfaction with the final product. Three different categories of decision making are typically distinguished (see e.g. [Carm 93]):

- **Consultative design**
  Users are invited to provide information to the decision makers. Little or no real influence is given to the users, who are primarily a source of information for IT staff, who retain the power of decision. This is still the most popular form of user involvement in design; User Liaison is an example for this category.

- **Representative design**
  This involves selected user representatives in the decision making process. Joint Application Design (JAD) belongs into this category [Dami 98].

- **Consensus design**
  Here, a share of responsibility for the design is assigned to the users. PD falls into this category.

PD emerged from Scandinavia in the late 1970's, when legislation requiring organisations to involve their employees in decisions potentially effecting their conditions of work was introduced in some Nordic countries.

In short, PD is based on the view that users can be important creative contributors to system design (and to an organisation as a whole) if they are allowed to express their views and insights, apply their specific expertise, use their decision making capabilities, and are given responsibility for the impact of these decisions. Moreover, it holds that good ideas are as likely to emerge bottom-up as they are to emerge top-down [Mill 93]. PD also challenges some long-standing assumptions and beliefs regarding technology and design. Issues raised include [Kuhn 93]:

- **Must we always analyse the impact of technology on people, or is there just as strong an impact of people on technology?**
  This question reveals the close relation between the ideas put forward by PD on the one hand and by the Social Shaping of Technology (SST) approach on the other. Yet, a major distinction lies in the fact that PD looks at the impact people may have on technology, whereas SST looks at the influence of the overall environment (including, among others, cultural and organisational norms, and people). SST will be discussed in more detail in sect. 2.2.

- **Can software professionals recognise the validity of perspectives others than their own?**
  PD promotes joint system development; all stakeholders, particularly including users and those people whose working life will be affected by the new system. Major pre-requisites here include mutual understanding and respect of all groups. The question also points to a communication problem that is likely to emerge between system designers and users (see also e.g. [Begg 93], [Gass 95]). This crucial need for mutual understanding will also be further discussed in sect. 2.2 below.

The primary goal of PD is the involvement of the individuals who do work in a process, or with a technology, in the designing of that process or technology. This implies the building of shared understanding and knowledge amongst the different stakeholders. From the PD point of view users are not experimental subjects, but key members of a design team; they are essential as active collaborators in the whole process of system design. That is, PD recognises the crucial role users can play during this process, as they are in the best position to contribute information about their work and their organisational and technical environment. They are experienced in the application domain, whereas designers are experienced in systems design. As both aspects are important, design needs to be done *with* users, not *for* them solely by designers - especially information technology can only be appropriately designed within the context of the workplace. Accordingly, users need to assist designers to get at a more accurate and realistic view of the actual environment within which the system to be designed will be used. It follows that mutual learning should be an important part of the work in a design group.

The social aspect of a design process is another important issue to be considered. This process does not necessarily follow strictly rational paths. Rather, subjective views, previous experiences and even prejudices on the side of the users (and, maybe to a lesser extent, on the side of the designers) may play an important role, and may well contribute to a system's success or failure [Grud 96]. Thus, users' perceptions and feelings about technology are as important as technical specifications or performance indices. Furthermore, because of users' active involvement in the process, they are more likely to accept a final system once it is actually implemented. Likewise, participation in the design process also prepares people for changes (which may well occur as a result of this process) [Harr 96].

Yet, all that glitters is not gold. The fundamental (potential) weakness of PD is its dependency on the effective communication between designers and users. In fact, this communication is a sine-qua-non for PD. Yet, there is a real risk of the communication between these two groups being unbalanced. More specifically, designers may presume greater importance for their specific, technical knowledge domain (as opposed to the less tangible knowledge contributed by the users) [Beath 96]. Similarly, users may consider their knowledge of the real-world organisational processes they are involved in as 'anecdotal' and, therefore, largely irrelevant. Likewise, it may well happen that users get overwhelmed by technical jargon, or become 'brainwashed' by designers' technical arguments and merely agree with their ideas [Novi 93]. As a result, communication becomes unbalanced, and the participatory design process is corrupted.

A different type of communication problems is also likely to occur in PD - rooted in the different 'languages' of designers and users. Accordingly, the need arises for a translation between the two groups, to overcome the respective individual members' different goals, training, experiences, and workplace cultures [Begg 93]. Again, both PD and standardisation face the danger of being corrupted by this imbalance. True participatory design can only be achieved if such imbalances can be avoided.

Above, we have already observed the similarities between design in general and standardisation (see sect. 2.5.1). Likewise, analogies between participatory design and standardisation can easily be identified - clearly, an ideal standardisation process should strictly follow PD principles, with all stakeholders being equally represented and having an equal say. To carry the analogy a little further, and looking at the respective tasks and roles, individual users in the design process correspond to representatives of user companies in standardisation, and designers correspond to vendor representatives. Unfortunately, this analogy also includes the unbalanced representation of the two groups, from which both processes may - and indeed do - suffer. In standardisation this imbalance is due to the extremely poor representation of users.

In today's standardisation processes, consensus and due process may be considered as the expression of participatory design principles in standardisation (see sect. 2.1.3). However, here again we observe unbalanced communication, due to the extremely poor representation of users in the committees. One of the major lessons standards setting bodies may learn from PD would be how to overcome these imbalances.

Another idea worth adopting is that of evolutionary design. In PD, this allows to adapt to e.g. organisational changes or changing workplace conditions. In standardisation, it would allow, for example, to react to new technological developments or new economic boundary conditions (see e.g. [Kos 88]).

2.1.5.3 Business Studies

One particular field from the vast variety of business studies could be potentially interesting to the standards setting community - the Virtual Enterprise (VE). VEs share a common underlying goal with today's standardisation bodies: to adapt to the fast changing environment they are operating in. Businesses have to struggle, among others, with ever smaller windows of opportunity for new products, and standardisation bodies need to deal with increasingly shorter life cycles of IT systems. This common predicament is the basic motivation for the following brief analysis, which is pursued in the hope to identify solutions found by the business community that could be adopted, at least in part, for the standards setting environment.

"A Virtual Enterprise is a temporary network of independent corporations joining forces to fulfill a particular task. To the outside, they appear as a unitary enterprise. All partners bring in their supplementing core competencies" (translated from [Fais 95]).

This definition of a VE exhibits major similarities with the characteristics of an ideal standards committee, yet also includes some differences. It includes several keywords upon which the following considerations and comparisons will be based.

- **Temporary**
  A VE is formed to meet a - potentially small - window of opportunity. This implies that no lengthy negotiations may take place (as would be necessary in case of e.g. a joint venture), and that resources will only be loosely coupled.

- **Network**
  A readily available communication and information infrastructure is a mandatory prerequisite of any VE.

- **Independent**
  Looking at the required infrastructure this raises compatibility issues, which can only be solved if standards based systems are employed by all partners.

- **Join forces**
  A network of relatively small entities may combine the benefits of a large enterprise (economy of scale) with those of small companies (e.g. flexibility).

Exploring the analogies between a VE and an IT standards working group the first correspondence lies in the motivation: increasingly shorter cycle times of IT products were the major driving force behind the concept of a VE, and they are at the centre of the discussion on the pace of standards setting, which is largely perceived as not being adequate. This similarity may at the same time also serve to justify the proposed analogy. On the other hand, the drastically reduced administrative and organisational overhead, and especially the temporary nature of a VE might well serve as models for the 'official' standardisation bodies, the major weaknesses of which include extensive bureaucracy and 'immortal' work groups (WGs). Likewise, better use of information and communication technology has long been on the agenda of all major bodies, with surprisingly little success, though (with the exception of the IETF, who have always been doing most of their work through e-mail).

As for the similarities, involvement of independent entities (e.g. different companies) features prominently. In fact, according to [Byrne 93], vendors, customers, and even erstwhile rivals may join a VE and contribute their respective core competencies - very much like they do in a standards WG - or rather should do, as the absence of users on the committees, and accordingly the lack of their core competence in the standards development process is a much lamented fact. That is to say, the WGs' products - the standards - are made without the competence of one party. Imagine a car being manufactured without the input from someone who knows how to design an engine..... This again is an issue where standards organisation might be well advised to explore the ideas underlying the concept of the virtual enterprise. The study of virtual enterprises might help those standardisation bodies wishing to better adapt to their fast changing environment. Research into VEs may provide guidelines on what needs to be done, what is required to do it, and what role the single stakeholders in standards setting have to assume in order to adapt.

2.2 Interactions Between IT and Its Environment

Technological artefacts in general, and especially such powerful representatives as information technology (IT) systems, will exert potentially strong impact on their environment. Complex interaction can be observed, where technology may assume both an active and a passive role; that is, technological artefacts and their environment are mutually interdependent. The environment within which technology is used and employed has, among others, social, cultural, societal, and organisational bahaviours, rules and norms. It is clear that technology cannot emerge completely independent from such external influences[47]. However, the impact IT may have on organisations, or indeed society as a whole, has thus far attracted considerably more attention than the powers that shape this technology in the first place. Especially the impact of IT within organisational settings (e.g. on a company's performance, or its role as an enabler of business process re-engineering) has been subject to a vast number of studies and analyses. Keywords such as 'management of change', 'technology management' and 'organisational transformation' can frequently be found in the literature, typically denoting studies on how the introduction and subsequent use of IT have changed a particular organisational environment - for better or worse (for discussions of different aspects of these problems see e.g. [Dani 94], [Gatt 90], [Hast 93], [Scott 91]). Only recently has the reverse direction of impact been studied, i.e. the one exerted from organisational and societal conditions on technology.

47 Like technology, standards are pre-shaped through the environment within which they are specified. This will be elaborated further below.

Two mutually exclusive schools have dominated research on technology and organisations until the early eighties (and are still in evidence). Proponents of the 'organisational choice' model consider technology as a vehicle to both reflect and foster the interests of particular groups; the process of change can be, and indeed is, shaped entirely by policy makers or organisation's managers; these actors have unlimited technological choices. *"Technology has no impact on people or performance in an organisation independent of the purposes of those who would use it, and the responses of those who have to work with it"* [Buch 85]. In contrast, 'technological determinism' in essence postulates that IT determines the behaviour of organisations, that the consequences of manipulating a given technology will always be the same, independent of who manipulates and within which context [Watad 96]. It follows that, according to this view, organisations have little choice but to adapt to the requirements of technology; particular paths of technological development are inevitable; like organisations, society at large also has no other choice but to adapt [Will 97a].

Research into the social shaping of technology (SST) largely emerged as a response to technological determinism. SST adopts a middle course between the two older approaches, acknowledging that technology indeed has an impact on its environment, but that at the same time it is well framed through technical, but rather more through e.g. organisational, societal, cultural and economic factors [Will 97a]. In particular, SST attempts to unveil the interactions between these technical and social factors [Fleck 95]. Abandoning the idea of inevitable technological developments implies that choices can be made regarding, for instance, the acquisition, the use and particularly the design of technological artefacts. There may be a broad variety of reasons upon which these choices may be based. In an organisational context this may include purely technical reasons, as e.g. the need to integrate legacy systems, but decisions may also take into account company particulars, as for instance organisational or reporting structures[48]. These choices, in turn, may lead to different impacts on the respective social or organisational environments. Thus, studying what shaped the particular technology offers a chance to proactively manipulate that very impact expected to result from this particular choice. At the same time this capability should also contribute to the prediction - and thus prevention - of undesirable side effects potentially resulting from a new technology. Technology tends to have other effects

[48] Local cultural norms may also be very influential. The ways in which information systems are used in Chinese companies, for example, differs considerably from those in Western cultures [Mart 96]. IS is shown to be used to reinforce and strengthen managerial power in the former, whereas broad access to information serves rather more as a leveller in the latter.

besides those actually intended, these effects need to be explored as well. On the other hand, the respective environment shapes technical artefacts and systems during design and in use, i.e. at the site of the actual implementation. The overall process that comprises the first design stage (of an invention), its production and the final implementation can be referred to as 'innovation'. It is this process I will now look to.

Innovation

In general, one can distinguish between two different views of innovations: from the vendor's and the user's perspective, respectively. The former is very much associated with R&D and, to a lesser degree, with marketing activities (see e.g. [Shod 95]), the latter is rather more concerned with implementation issues and effective deployment of an innovation. While the focus of this section will be on implementation, let us briefly look at the 'vendor-specific' view. Figure 2.2.1 shows an adaptation of the Chain-Link model as described in [OECD 95b], depicting the relation between a company's knowledge and its R&D capabilities, and market opportunities. It also shows the relations that exist between invention, design and test. It should be noted that this model does not depict the implementation of the final outcome of an innovation. Rather, it is only concerned with invention, design and marketing, which is understandable given the underlying point of view from which innovation is looked at.

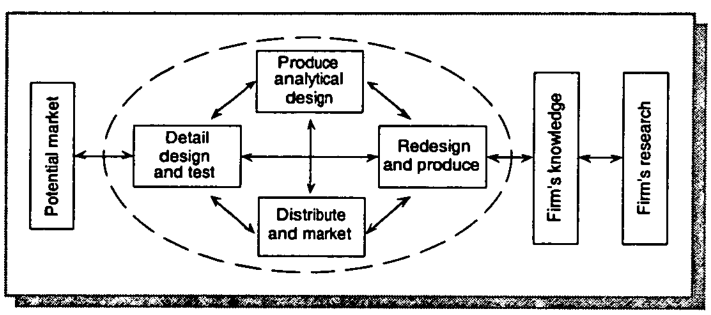

Figure 2.2.1: The Chain-Link Model
(taken from [Shod 95])

Coming back to the user's view of innovations one can hardly ignore the 'traditional' linear model of the innovation process. As the name already indicates, it suggests a purely linear relation between the initial invention, the production process and the implementation (depicted in Figure 2.2.2, see also e.g. [Rhod 94b]). Despite its flaws this model can still frequently be found and will therefore be discussed here.

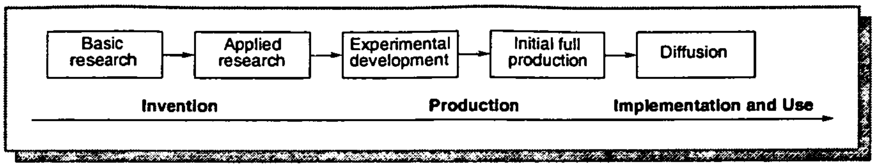

Figure 2.2.2: The Basic Linear Model of Innovation

The model clearly reflects the technological determinism mentioned above. Basically, it identifies three distinct phases [Scar 92]:

- **Invention**
  The actual invention happens during this stage.

- **Production**
  An artefact based on the original invention is designed.

- **Implementation[49] and Use**
  The artefact is applied to particular tasks.

One of the model's distinct features is the assumption that specialist knowledge from rather different disciplines can be brought together and accumulated in a sequential order, a supposition that is not very realistic. Moreover, it fails to address the contradictory and uncertain nature of innovation, which is subject to various influences of different nature, including economical and political powers [Will 92], not to mention the various twists, U-turns and detours typically taken in the course of a development process. The model also assumes the absence of any feedback from a later stage of the process to a previous one. Thus, it deprives itself of crucial sources of innovation outside its linear pre-determined course. Incorporating this notion into the linear model leads to a slightly different model, which at least allows to overcome this particular weakness (see Figure 2.2.3).

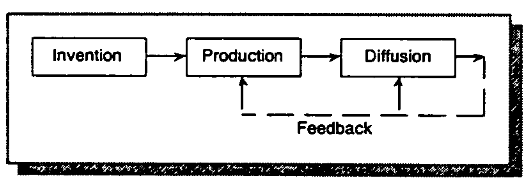

Figure 2.2.3: An Extended Linear Model
(adapted from [Fleck 95])

[49] The term 'implementation' is used here to denote *"the process through which resources are configured to provide an efficiently operating system"* [Finch 94].

It should be acknowledged that this extended model may be applied to products aiming at the consumer market, which typically originate from one producer's lab, and where the only feedback from the market (i.e. the users) basically is a binary success/failure message (i.e. the product has been accepted, or it has not)[50] [Fleck 95]. However, the crucial role of customers during the innovation process should now be obvious. In the case of a mass-market product customers decide about its success or failure. Similarly, in case of IT systems to be implemented at an organisation's site, it is to a considerable degree up to the end-users to either accept a system or reject it). The recent trend towards end-user computing (see e.g. [Bran 93], [Comp 95], [McLean 93]) not least reflects the fact that organisations have realised the importance of the perceptions of their end-users and organisational sub-units regarding IT systems, and of the benefits of systems well adapted to their respective local environment (for a discussion of the potential drawbacks of this approach see sect. 5.3). This observation is closely related to the phenomena of individual and organisational learning, the presence of which may significantly contribute to the success of an innovation [Atte 92].

Having a choice - as claimed above - immediately suggests that innovations do not necessarily follow a single path leading directly from invention to diffusion. In the following I will therefore look at the relations that exist between the original invention and its final implementation.

Innovation and Implementation

Thus far activities following an original invention, particularly the adaptation process within the user's environment, have been considered as being distinct from the invention itself. In particular, inventions have typically been associated with universities and research labs, whereas implementations take place at plant floors or within offices. Moreover, implementations are frequently regarded as being less exciting and, indeed, trivial when compared to the efforts that have to go into the original invention. The implicitly underlying idea basically is that invention equals innovation (at least as a first approximation). Any subsequent activities, such as transforming an invention into technology, and putting this technology to good use within a specific environment, are held in low esteem [Scar 92]. However, more recently "*.... enterprises that consider innovation part of their strategy are beginning to realize that the implementation of technological innovations in particular is a complex*

[50] In this respect the model resembles software engineering's waterfall model (see e.g. [Ghezz 91], the major weakness of which also is the lack of feedback mechanisms (see also sect. 2.1.4).

matter in which ..... many interrelated factors play a role." [Corzi 93]. Figure 2.2.4 shows these factors.

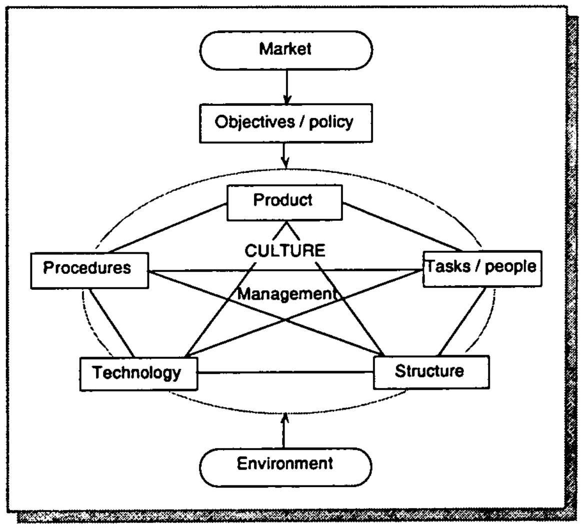

Figure 2.2.4: Contributors to a Successful Implementation of an Innovation in an Organisation
(adapted from [Cozi 93])

It can clearly be seen that the implementation of an invention can affect almost all aspects of an organisation. In particular, it shows that the organisational culture, its management and its environment are essential for a successful implementation (MIT's 'Management in the 1990s' programme used a very similar model, see [Scott 91]). Thus, an implementation must be considered an integral part of the overall innovation process. It has frequently been shown that - apart from research labs - there are other sites of invention, most notably the user's respective environment (see also e.g. [Fleck 88] and [Roth 94]). Users are in a position to invent their own tools (as reported e.g. in [vHipp 76]); they should as well be able to cooperate in, and provide constructive feedback on inventions and innovations. In fact, as we will see below, the actual implementation of an invention itself is indeed a major potential source of innovations. An organisation's capability to innovate depends on its inherent innovation potential. Figure 2.2.5 shows the different contributors to this potential, most of which can be linked to the corporation's culture. For example, it makes a major difference if internal innovation efforts are supported or discouraged, or if a company has been comfortably installed in the market or if it is a new player trying to establish itself.

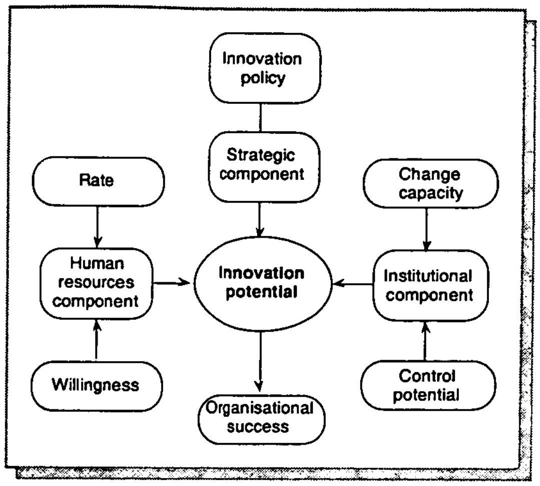

Figure 2.2.5: Contributors to a Company's Innovation Potential

In the light of the above deliberations we can now look at the linear model's deficiencies and weaknesses. This analysis should also contribute to a better understanding of the nature of innovation processes, and especially of the issues surrounding the implementation of an innovation. For one, the single source of an innovation gives rise to the question what actually causes innovations to happen. The linear model seems to suggest technological progress to be the only driving power behind innovations. In other words, it exclusively supports the 'technology push' view, as opposed to the 'market pull' view that is based on the notion that innovations are called in by the market. However, research has shown that no primacy for either view can be established; rather, technological pull seems to be more significant during the early stages of a development, whereas subsequently market-pull dominates when the technology matures [Coomb 94]. Moreover, we note that the model assumes the existence of a single, well-defined source of an invention, typically an R&D lab or some other research institution. Yet, inventions rarely come out of the blue, but the model does not offer anything to explain if, and how, an invention is based on earlier developments, and/or how it has been preshaped by the context out of which it emerged. A simple yet instructive example of the latter, although at an individual level - as opposed to the organisational one - may serve to underpin the observation that an originating context indeed shapes technological artefacts that emerge from it: a 'machine-centred' perception of technology has been found to be popular among engineers [Rhod 94b]. It has also been observed that many machine designs frequently fail to utilise the capabilities of their human operators, which in turn yields highly unsatisfactory jobs. Moreover, the relation between system design and job performance, and work attitude, are completely ignored by many machine designers. *"Occupational paradigms tend to suppress the ability to see alternatives* *which do not conform with the prevailing assumptions"* [Rosen 81]. Linking these observations directly leads to the conclusion that a machine-centred view on the side of the vendor's designers may well be at the bottom of a user-unfriendly design.

The linear model also postulates that technology does not fail to deliver a solution which meets actual user needs and requirements [Will 97a]. The above example already challenges this assumption. In addition, and maybe worse, even today's requirements are rarely fixed, or even really understood. This holds not least for those who are supposed to know best - the users themselves. In fact, it has been shown that even for some comparably simple technologies it may well take years for an organisation to develop a reasonably good understanding of other than the very basic technical requirements (see e.g. [Jak 97a] and also sect. 5.3), not to mention organisational and other non-technical needs[51]. If today's requirements are not fully understood, how can future needs be anticipated? Facing the enormous pace of development in the field of information technology, and the changing environment they are operating in - especially the increasing globalisation of markets - company structures have been changing as well. Exploitation of suitable IT systems and services has been an indispensable part of this process. Here, virtual enterprises are an instructive example of how new possibilities have only been enabled through information technology, and thus of the impact IT may have on organisations (see e.g. [Zimm 96]). Requirements on the technology are going to change along with the environment. In this state of flux it cannot realistically be assumed that future requirements on, or indeed future uses of a technology can be predicted from the outset with any reasonable degree of accuracy.

We can now safely dismiss the rather deterministic view of technological change underlying the linear model. Instead, we have to recognise that the implementation of a technological system is a continuous, complex exercise, and an integral part of an overall innovation process, and that innovation only materialises as the result of the interaction of a number of factors. In particular, feedback from users and communication between vendors and users are crucial prerequisites of a successful innovation. Accordingly, a new model has to be devised. Somewhat surprisingly, relatively few such models can be found in the literature. Leonard-Barton tries to

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[51] It has frequently been observed that particularly systems aimed to support group work risk initial rejection (see e.g. [Gran 95], [Grud 88]). This is primarily due to users having problems to envisage the benefits of the new system, and its ability to meet organisational needs. Moreover, potentially changing work patterns and inadequate match of system capabilities and its work environment contribute to a certain inertia on the side of the end-users [Fran 95].

model the mutual adaptation of technology and organisation as a recursive process [Leon 94]. The model comprises of a series of large cycles of re-evaluation for both technology and the user environment. Within each such large cycle small cycles of incremental innovation take place. It also suggests that a stable point can be reached which represents a joint optimum for both technology and organisation. The existence of this point has been challenged in [Winch 93]. Their initial model comprised of the three stages 'evaluation', 'installation' and 'consolidation'. However, a subsequent test in a number of case studies resulted in a major overhaul of this model. This modification was necessary due to the non-linearity between the single stages and the inhomogeneities within each of them which could be observed in the case studies. In particular, they argue that *"... the recursive, interactive and lagged nature of the implementation process means that equilibrium is highly unlikely to be reached"*. Accordingly, continuous change has to be assumed. Their revised model is depicted in Figure 2.2.6. It shows the three stages defined initially in a recursive relationship; each re-evaluation is based on the experiences gained through earlier stages. Implementation is considered as a continuous process.

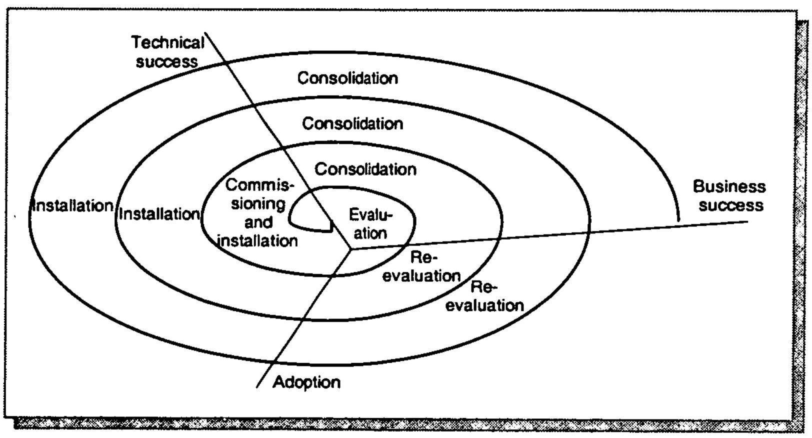

Figure 2.2.6: A Dynamic Model of the Implementation Process
(adapted from [Winch 93])

A close relative of this model can be found in software engineering, where it is used to model software development processes (see sect. 2.1.4). We can now summarise the different factors and entities that shape technology and innovations. They include

- **The context from which the invention emerges, including**
  - designers' views [Rosen 81],
  - vendors' preferences and strategies [Jak 96g].

- **The environment where it is to be implemented, including**
  - work and organisational actualities [Will 97a],
  - end-user attitudes [Yav 88],
  - managerial guidance [Leon 88],
  - successful cooperation between stakeholders [Will 97a],
  - adequate innovation potential [Rhod 94b].

- **External forces, including**
  - advances in science and technology [Pav 91],
  - prevailing societal norms [Mart 96],
  - legislation.

Given this diversity of stakeholders with different backgrounds, perceptions and interests communication is (one of) the most important issues in such an environment.

Aligning Perceptions

At least in the case of more complex systems innovation is not just a simple bilateral exercise, involving only vendor and user. Rather, there is a need to engage other players in the process, including component vendors, producers of complementary products (e.g. vendors of gateways if an inter-organisational e-mail system is to be implemented), users, policy makers, and possibly external consultants. Visions of an innovation need to be communicated to this variety of potential stakeholders. Therefore, despite the typical need for quick innovations, a certain amount of stability is also desirable, during which this communication can take place. That is, potential stakeholders' perceptions of the future course of an innovation need to be aligned. This *"alignment of perception is an important step in innovation"* [Will 97a]. Along a similar line of thought, Orlikowski has established the concept of 'Frames' (see e.g. [Orli 91]). She observes that different groups (like e.g. the ones referred to above) will have different views and expectations of a certain technology. These are based on previous experience, expectations and assumptions, however well grounded they may be. If the respective frames are incompatible, major problems are likely to occur. For instance, users, company strategists and technologists will have very different frames regarding a given technology; a result of, inter alia, different backgrounds and job duties. [Orli 91] also identifies a number of general categories of such frames based on literature studies. A later case study, however, demonstrates that technological frames are context specific [Orli 94]. This makes things even worse; not only need the frames of the single stakeholders be aligned, but to a great extent this alignment can only be done on a case-by-case basis due to the different contexts from which the frames emerged, and which are likely to have shaped them. She shows that for an environment and a technology similar to those considered in this study three distinct frame domains could be identified, including nature of technology, technology strategy (i.e. peoples' views of why a technology was implemented), and technology in use (i.e. their understanding how to use a technology).

It is fairly obvious that the views regarding, for instance, potential use of a certain technology will differ between the group of actual end-users on the one hand and the IT department on the other. These different views have primarily been shaped by the different tasks; the former need to apply the system as part of their day-to-day work; it is supposed to make their working life easier and/or more efficient. In contrast, the latter are primarily interested in a smoothly working system. Accordingly, users will look for user-friendly, well-integrated systems providing adequate functionality, whereas the focus of central IT will be on easy manageability, homogeneity and extensibility. It can be seen that the frames of these groups are far from being aligned, and trying to achieve alignment will require learning on both sides, which in turn will again require communication and mutual understanding. Likewise, knowledge regarding the specific local environment brought in by the end users and the customer's managers is as necessary during an implementation as is the technical know-how provided by the vendor. These two knowledge domains are typically extremely separate, and have most likely always been. In most cases, the relations between vendor and customer are strictly formal (i.e. ruled by contracts) [Fleck 88]. Thus, informal communication networks did not exist prior to the implementation activity, nor has there been a chance to develop the necessary common ground of understanding; extensive knowledge transfer between these domains in both directions will only take place during the process of implementation [Bier 92]. This, in turn, is impossible without a common understanding of what the technology is supposed to achieve. These observations again stress the need to align the technological frames of all stakeholders[52].

Finally, even if an invention exclusively originated from, say, one particular research lab, it has been subject to, and formed by, this lab's context, including the local organisational environment as well as the broader societal and political culture.

52 Virtually the same problem exists with respect to communication within working groups of the standards setting bodies,where users need to convey their needs and requirements to very technical people.

Technological artefacts embody, and thus transfer, their environment of origin. This alone implies that adaptations will subsequently be required if an invention is to be exported to other markets, or user organisations, in different environments. As Williams observes *"The shaping process begins with the earliest stages of research and development"* [Will 92]. This observation points to the direct link that exists between innovation and standardisation activities. Especially since the advent of pro-active standardisation technological systems have increasingly been rooted in standards activities rather than, possibly modified, already existing products (as it is the case in reactive standardisation). As a consequence, it will no longer suffice if users talk to, and cooperate with, their vendors during implementation. Instead, cooperation will have to start far earlier. That is, accepting the above notion that shaping of technology starts at the earliest possible stage implies that users will have to look closer at standards committees if they do not want to risk being eventually stranded with a technology incapable of meeting their needs. 'Standards' have also attracted attention in another context, which will be discussed below.

Configurational Technology

In today's networked environment technological systems are becoming increasingly complex. Some of these systems evolve into what has been called 'generic technological systems'; prominent examples include railroads, power supply and telecommunication networks [Fleck 95][53]. Such systems are not a coherent whole,

53 Whether telecommunication networks are indeed 'generic' may require additional discussion. In particular, it appears somewhat questionable whether it actually makes sense to consider such an extremely complex and heterogeneous structure like the GII as one 'generic' system (in the sense of 'a system where standardisation takes place at the overall level' as, albeit indirectly, suggested in e.g. [Fleck 92]). I would argue that even in the far less complex case of e-mail, for example, a service which forms only a tiny part of the GII, there is no such thing as system-level standardisation. Considering the overall e-mail system, we find that it comprises a number of very different artefacts; including LAN- and mainframe-based systems, gateways, a wide range of end-systems, and backbone networks. This conglomeration of very heterogeneous artefacts, serving different purposes cannot be subject to one overarching, system-level standard.
At most you can perhaps consider a system like an X.400-based backbone network as 'generic'; here, standards have emerged at system level, and only minor changes are likely to occur in the future. Yet, the idea initially underlying the X.400 recommendation series to establish such a system (i.e. 'X.400 to the desktop') had to be abandoned with the advent of LAN-based e-mail systems at the very latest. These days, X.400 typically serves as a backbone network interconnecting the single proprietary, local systems. Accordingly, any overall standard would somehow have to include these systems as well, which is neither realistic nor really desirable, due to their potential of being highly configurational and tailored to meet local needs.
Accordingly, as only component-level standardisation may be expected, but no standardisation at system level, not even e-mail exhibits the characteristics of a generic system. The situation is similar for other ICT systems. Indeed, it may be a matter of debate whether complex, hierarchically structured ICT systems can be 'generic' at all.

rather, they have been established through the interconnection and interoperation of a large number of smaller systems, which are easier to handle, to manage and to modify. These smaller systems then need to be integrated into the overall system; often they are interconnected through dedicated interworking units. There is an obvious need for standards[54] in such environments, which typically involve different technologies from different vendors. Without standards it would be impossible to achieve interoperability at the required scale. On the other hand, high-level standards may also emerge from such complex systems. These standards will be at system level, incorporating the single component and interface standards.

The need for the single components to cooperate smoothly also leads to 'natural trajectories' of development (as e.g. mechanisation or economies of scale, [Fleck 88]). Here, a technological bottleneck in a certain area can hamper the progress of the overall system. Thus, this bottleneck (or 'reverse salient' as termed by Hughes [Hugh 87]) will attract the attention of a number of entities trying to solve the problem. This, in turn, will lead to progress in this particular field, possibly leaving behind others, on which interest and innovation efforts will subsequently concentrate. These gradual improvements are characteristic for generic systems, which typically exhibit their high degree of standardisation not least due to technological 'path dependencies'[55].

Some large systems, however, may not follow such trajectories. Typically, each of them is particularly well integrated into its local environment, and closely follows this environment's particular contingencies; that is, these systems are configured to optimally meet the respective local requirements. Such close adaptation to a local context is likely to lower the general interest in such systems, which implies that they will not generate any large-scale standardisation activity. Implementation of such systems requires considerable efforts, and would be next to impossible without far-ranging input from users, who are the only ones to know their environment sufficiently well. It is especially in those cases that the site of an implementation at the same time is a site of considerable innovation; in fact, the implementation itself becomes a source of innovation, as additional innovations become necessary for the adaptation to the local context. As a result, the distinction between innovation and implementation becomes meaningless in this environment, and the processes of

[54] Many representatives of SST exhibit a strange 'laissez-faire' attitude towards the use of terms like 'standard' and 'standardised'. This topic will be elaborated on later in this chapter.

[55] This term points to the fact that innovations are also shaped by earlier developments; technological lock-ins may also occur due to this dependency.

invention, innovation and diffusion collapse into a process coined 'innofusion', with feedback occurring primarily through internal learning processes [Fleck 88]. Such systems are referred to as 'configurational'; they have been configured from a wide range of components, from different vendors to optimally meet the need of their local environment. Most likely, given the customised nature of the system, some, maybe even the majority of components have been developed in-house[56].

The resulting role of users as innovators should have become obvious by now; indeed, it has been stressed by may authors (see e.g. [Fleck 94], [Roth 94], [Will 97a]). However, it is worthwhile to note that this seems to refer solely to 'business-relevant' systems (like e.g. CIM), as opposed to 'infrastructural' systems (as e.g. the underlying communication network). To some extent this classification has been borrowed from the usability literature, where the concept of 'enabling tasks/states'[57] and 'goal tasks/states' has been developed within the framework of the RACE[58] usage projects (see e.g. [May 93], [White 92]). Underlying this distinction is the observation (which is almost a truism) that a user of an IT system wants this system's help to achieve a certain goal. This requires the system to be able to perform a number of activities and transactions that enable the user to actually achieve his goal - i.e. the system must be brought into an enabling state, where it is capable of performing enabling tasks, which in turn eventually leads to the accomplishment of the goal task. To bring the system into an enabling state the user will at least have to convey some information about the particular goal task at hand[59]. That is, the user has to communicate with the system, which represents an activity which is not directly related to the task at hand, but which is only required to accommodate the system's internal structure and functionality. As such activities detract the user from his actual work it would clearly be desirable if this detraction could be minimised.

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56 However, it has been observed that there is a trend, especially in times of recession, to buying software packages rather than pursue in-house developments [Rock 92].

57 *"An enabling state is the set of preconditions necessary for a user to execute a goal task. The state consists of the states of all relevant components of the system including the end-user. An enabling state consists of a dynamic organisation of nested services and main communication channel characteristics for each user goal task".*
"An enabling task are tasks that aim to create the preconditions for goal tasks. They can only be defined with respect to an enabling state." [LePe 92].

58 Research and Development in Advanced Communications Technologies in Europe, a European R&D programme.

59 [May 93] gives the example of an ATM machine, where even in the most simple case users have to specify the amount of cash they need, insert a card, type a PIN, remove the card, wait for their cash, and finally take their cash. Here, only the last action corresponds to the goal task, whereas the other five activities correspond to enabling tasks.

The correspondence between infrastructural systems and enabling tasks should be obvious: the infrastructure performs the tasks necessary to make an application work (which itself may either itself be a business relevant system or be performed by one). For example, if an application wants to send an EDI[60] message, this may require the invocation of a directory service to find out the recipient's electronic address, and of an electronic mail service to actually transport the invoice (not to mention the communication oriented functionality of the lower levels which is in turn required from these comparably high-level services). Whilst the end-user will not normally have to interfere here (in fact, he will not know at all that other services have been used), the whole communication system underlying the EDI application will have to perform enabling tasks. It is clearly desirable that this system has been designed adequately. If in the above example the e-mail service were not capable of providing security services, for instance, and the application required a secure transmission of the invoice, not all enabling tasks necessary to perform the goal task could be executed and therefore the goal would not be achieved. Accordingly, observing the distinction between enabler and goal should also be helpful during the (re-)design of a corporate IT system, which needs to support a variety of applications and should therefore be built as flexible and versatile as possible[61].

The distinction between 'business relevant' and 'infrastructural' systems is crucial not least because of the different priorities typically assigned to these systems. In [Ben 93], Benjamin, for example, notes that *"Companies often lack an infrastructure that can support common processes. A return-on-investment case can be made for process change, but it is much more difficult to do so for the infrastructure that must be in place in anticipation of the process"*. Somewhat surprisingly, thus far almost all writers discussing innovations have only looked at what must be considered business relevant technology (for some examples see [Fleck 88] (Robotics), [Riggs 94], [vHipp 76] (scientific instruments), [Winch 93] (CAD/CAM systems)). On the other hand, literature focussing on rather more business-related issues has discussed the relevance and strategic importance of an adequate IT infrastructure, especially in the realm of business re-engineering projects. Venkatraman [Venka 91] distinguishes

60 Electronic Data Interchange, protocols and services relating to the electronic exchange of formatted trading documents, as e.g. orders and invoices.

61 A similar philosophy can also be found in the application layer of the OSI Reference Model [ISO 94a], where a set of commonly used functions (common application service elements) represents the underlying 'infrastructure' for the 'actual' application layer services such as file transfer or the directory.

between three different treatments of corporate IT infrastructures in relation to the company's strategy, which are summarised in Table 2.2.1.

Type 1 Independent	Type 2 Reactive	Type 3 Interdependent
Low level IT function	Trend towards greater importance of IT	IT is critical function
Operational IT planning	IT planning derived from business plans	IT planning identifies and responds to business opportunities
'Administrative expense'	'Business expense'	'Business investment'

Table 2.2.1: Characteristics of the Three Types of IT Infrastructure Vision

The potential consequences of the organisations' different perceptions regarding their respective IT infrastructure will be discussed in more detail in chapter 7.

In any heterogeneous environment there is an obvious need to find a balance between optimally meeting local requirements (through specifically developed systems, which is expensive) and using standardised, and therefore cheap, components. One possible way out of this dilemma could be the extensive use of very small, standardised, and openly available components (as e.g. off-the-shelf software packages) which can be freely configured to meet a wide range of demands[62]. This approach combines the benefits of mass-products (i.e. cheapness and stability) with a reasonably high number of applications that can be realised through combination and integration of the single components (see e.g. [Proc 96], [Rock 92]). The resulting custom-designed system can then be fine-tuned to optimally fit into its environment [Tass 95]. Following this approach, however, may introduce the new problem of how to deal with legacy systems. A very similar strategy is reported in [Bier 92], who notes that 'standard' software components are widely used within the German industry, yet with certain limitations in terms of their application area. He notes that such 'standard' components are primarily used rather generically, for instance for accounting and personnel management. If their business is affected, most companies resort to custom-made software products [Busch 89]. Here again we find evidence supporting the suggested differentiation between infrastructural and business relevant technologies. As we will

[62] SST seems to suggest an approach like this (see e.g. [Will 97a]). However, SST also draws attention to the existence of path dependencies of technology. That is, technology is influenced by, and has to cope with, its predecessors. Unfortunately, the pick-and-mix approach does not really offer a way how to deal with these legacy systems.

see later (sect. 7), an organisation's perception of a services as being business relevant will inter alia have a major impact on this organisation's willingness to spend money on it and, in particular, to actively participate in standards setting.

Standards

Standards[63] are the sine-qua-non for both generic and configurational systems; it does not even matter too much whether these standards have emerged through the 'official' process, through consortia, or simply through the market power of a dominating player (given they are globally accepted and used, that is). Moreover, Mansell notes that *"... the interdependence of standardization with factors that contribute to the innovation process ..."* positions standards setting bodies between technical and organisational change; indeed, they are the 'institutional glue' between these two domains [Mans 95]. However, not unlike technology (as discussed above), standards originate from a particular environment. Especially economic forces will influence the particular design of a standard and, maybe more so, the decision whether or not a standard will emerge at all. The four different basic economic situations, and their respective impact on the development - or non-development - of a standard have been outlined in sect. 2.1.4. Recently, coalitions of players - that is to say, consortia - have been formed at a surprising pace and variety [Carg 95]. This is not too surprising at all, given the huge R&D costs associated with the development, and subsequent standardisation, of a new technology. Gains to be expected from a successful technology, however, will more than compensate for these costs, and forming a consortium is widely believed to be a safe way to success. A popular theory of the diffusion of innovations teaches that a 'critical mass' of users needs to be reached before an innovation really gets off the ground[64] (see e.g. [Rog 95b], [Weib 95]). This holds all the more for systems with network externalities (as e.g. communication networks). Forming a consortium to develop and push a technical specification is considered by many as an appropriate first step towards achieving this critical mass (see e.g. [Upde 95]), guaranteeing success of subsequent products.

In the field of communication systems both standards and open technical specifications have been very successful (take ISDN and Ethernet, respectively, as examples). They basically represent the aligned expectations and requirements of, and necessary

63 The term 'standard' is used here in the broad sense of *"some well specified way of performing a particular task"* [Cowan 92], as opposed to the definition given in sect. 2.1.1.

64 *"A critical mass occurs at the point at which enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining"* [Rog 95a].

compromises between, a sufficiently large group of stakeholders (including vendors, service providers and users), primarily of course of those who were represented in the originating committee. Yet, whilst backing by a large enough number of committee members may suffice for a certain standard (or a specification) to materialise it is by no means guaranteed that this standard will subsequently succeed in the market place, i.e. that products built around it will be viable. Thus, to establish an environment favourable for the envisaged new standard (or rather, the products or services based on this standard), and prior to the actual technical work strategic, organisational, political and societal issues have to be addressed and resolved to bring these requirements in line.

The attempt to apply the critical mass approach to data communication services has seen some criticism (see e.g. [Kubi 95a], [Heil 95]). This critique is largely motivated by the differences between actually observable diffusion processes of data communication services and those that should occur if the critical mass theory could be applied. This difference, in turn, is claimed to be rooted in the lack of accepted international standards [Kubi 95a], and in a variety of economical and organisational factors. Regarding the latter, it is said that the asymmetric distribution of benefits and costs was a major contributor to this phenomenon; with EDI, for instance, it is the recipient who reaps most of the benefits e.g. in terms of costs savings thanks to increasingly automated data processing capabilities. Moreover, the existence of closed user groups, between which virtually no communication occurs, is inconsistent with the critical mass theory. Even if the overall number of users increases network externalities do not necessarily grow for members of such a group if the number of group members remains constant. Even other technical developments may interfere with the diffusion of a given service; emerging digital mobile networks hampered the growth of their analogue predecessors [Heil 95], and the advent of ATM virtually stopped the development of DQDB[65] systems. These observations make the assumption underlying the critical mass theory - a critical mass of users is the one determining factor for success or failure of an innovation - questionable[66]. On the

65 DQDB stands for Distributed Queue, Dual Bus, a system originally envisaged to establish the basis of metropolitan area networks.

66 It should be noted, though, that parts of the analysis presented in [Kubi 95a] were apparently done too early. With hindsight we see that some observations upon which the conclusions are based are no longer valid. For instance, while it is true that the diffusion of data communication services lagged way behind the prognoses in the early to mid-nineties, this situation has changed dramatically by now (1997) thanks to the exponential growth of the Internet. Electronic Cash was likewise not very popular with retailers at that time. In the meantime, however, it has definitely taken off (at least in Germany). And finally, while it is true that the international X.25

other hand, it could be argued that while those factors indeed have an impact on the formation of a critical mass, and may hinder or foil the formation, this does not necessarily question the theory as such, as these are only a few more variables which may or may not have an impact on the formation of a critical mass. However, a discussion of the critical mass theory is well beyond the scope of this chapter.

The above observations point to the need of exploring potential markets; if necessary and possible, they should created in advance. Moreover, a degree of confidence on the sides of both users and other vendors, that the technology will not soon become obsolete is important as well [Swann 90]. Especially for the latter any development will benefit from a-priori commitments by other vendors, including those of complementing products and even potential competitors - not least hence the popularity of consortia, as cooperation in a consortium with the aim of designing an open common standard will at least increase the likelihood of vendor commitment.

Cowan notes that *"Technical standardization is closely related to technology choice"* [Cowan 92]. It follows that end-user cooperation in technical standardisation is similarly crucial as is their involvement in technology implementation. However, whilst their primary task in implementation is the communication of specific knowledge regarding their work environment, such special knowledge is of little use in standardisation. Rather, their role here will focus on the contribution of technical and functional requirements (which, in turn, are rooted in a specific work context). With some justification it may be stated that end-users within an organisation are similar to consumers in several respects: there is little, if any, direct engagement between a vendor and an end-user. Consequently, in most cases, the vendor's engineers and designers have little, if any, knowledge about the particular settings within which their system is employed. Likewise, both end-users and consumers have little, if any, say in standards setting[67].

based public packet switched networks have never been too successful in terms of the volume of information transmitted, its technological successor - Frame Relay - certainly is. It could be concluded from these observations that in 1994 the critical mass simply had not been reached. However, it must not be overlooked that the take-off of the Internet, and especially of the Wold Wide Web, represented a quantum leap in terms of transmitted data volume, without which the statements regarding success and failure of data communication services would possibly have been true.
Basically the same may be observed with respect to the analysis presented in [Moli 92], where increasing importance was predicted for the RISC microprocessor architecture. From what we can see today, this did not happen. On the contrary, the crucial PC market is still dominated by intel's CISC processors. This dominance is almost exclusively threatened (if at all) by companies producing intel-compatible processors.

67 For a report on the current state of consumer participation in standardisation see [ANEC 95].

These observations reveal a striking discrepancy between the long-standing efforts to integrate users into the design process particularly of software systems (see e.g. [Kos 88], [Lind 94b], [Green 91]) and the comparably low-key efforts undertaken to attract users to standardisation activities. This comes all the more as a surprise since standardisation activities pretty much resemble design processes. However, standardisation bodies' committees and working groups have almost exclusively been populated by vendors and service providers [Jak 97a] and accordingly been driven by considerations focussing on their native interests, assigning a higher priority to e.g. a system's manageability than to its usability and user-friendliness [Jak 96d]. Another striking gap can be identified between the broadly agreed importance of standards, and the superficial way this subject is addressed by many SST writers (see e.g. [Fleck 95], [Bier 92], [Dank 92]), where apparently a standard is little else but something a group of sufficiently influential players (maybe just one) have somehow agreed upon. In particular, it is not clear whether the term refers to internal company 'standards', proprietary 'standards', 'official' base standards, or maybe standard profiles; indiscriminate references to all these types may be found. I would argue that a clearer definition of what constitutes a 'standard' is urgently required. Consider the following example: a company is running an internal information system based on an in-house specification (or 'standard'). No data from this system need to be exchanged with the outside world, so the situation is fine. Eventually, the company is pushed by a major customer into being able to exchange data with their system (this is not at all that unlikely, GM's MAP initiative is a case in point [Dank 92], and [Webs 95] reports similar developments regarding use of EDI in the UK retail sector). A dedicated intermediate system will be required to map their data structures onto those of the customer, a development likely to incur major expenditures and a likely loss of functionality. In such cases, in-house and proprietary 'standards' are of little use; only rigorous use of 'official' standards from the outset, i.e. those issued, for example, by ISO, or of widely accepted industry standards can help avoid this situation altogether.

It may be concluded that a closer look at standards is required, and that distinctions need to be made between the different types of 'standards' listed above. This holds all the more in an increasingly competitive international business environment, where the seamless exchange of information between business partners is becoming more and more important. The most convenient, and ultimately the only way to actually achieve seamless interoperability between previously separate and different IT systems, without any loss of functionality, will be the use of standards[68]. These observations also serve as a motivation to look closer at issues relating to the development of international standards. If users had an adequate say in the definition of these standards, and thus, although rather more implicitly, in the functionality of subsequent products incorporating, or based on them it should be possible to significantly decrease the number of standards developments that do not live up to the market needs. In the same way, by moving the beginning of a cooperation between vendors and users from the stage of a system implementation to the earlier stage of standards specification it should be possible to reduce subsequent efforts required to implement this system. Finally, adding a clearer view of what standards are, and especially how they are developed to the SST literature should enable a refined understanding of where, and by whom, technology is (pre)-shaped as well as a better prediction of the outcome of technological innovations.

2.3 Defining the Term 'User'

The concept of the 'user' is becoming progressively more complex. For example, an ISO Working Group charged with identifying user requirements reportedly failed, and was disbanded in the early 1990s, not least because they could not come up with a meaningful, and agreed, definition of what constitutes a 'user' [Jak 96d]. In 1996, the same happened to ITU-T's Study Group 1, the task of which was to provide service definitions, i.e. user requirements. The former activities of SG 1 have now been merged with those of other SGs [ITU 96].

Typically, the term 'user' is employed in very different contexts, and with very different meanings. Several attempts have been made to get a grasp of the 'user' (including [Fisch 90], [Foray 95], [Naem 95], [Salt 96]). [Naem 95], for instance, uses the OSI Reference Model (OSI-RM, [ISO 94a]) to describe a hierarchy of users (Figure 2.3.1). Within this model, an entity of layer (N) uses services provided by layer (N-1), and offers services to layer (N+1) (Figure 2.3.1a). The overall communication functionality is provided by a hierarchy of seven layers (Figure 2.3.1b). Applying this model to users is intuitive; for instance, an end-user has a requirement, passes it to the system administrator who, in turn, translates it into a system requirement which is passed to a system integrator, who will forward it to the network operator if necessary (see Figure 2.3.1c).

68 Please note the missing quotes here.

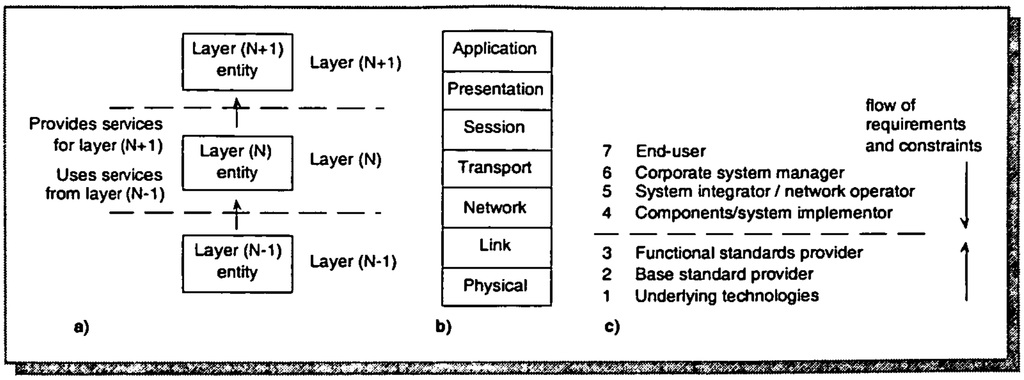

Figure 2.3.1: User Hierarchies and the OSI Reference Model
a) Interaction Between Layers in the OSI/RM (slightly modified)
b) The Seven Layers of the OSI/RM
c) The Layered Model of User Classes (according to [Naem 95])

Yet, even this apparently straightforward model has its weaknesses. Whilst it shows the likely flow of requirements within the upper four layers it fails to do so for the lower three layers, where this flow is rather more in the reverse direction, if a real flow can be identified at all. The underlying technology imposes constraints upon a base standard (provider), which in turn leaves only options to be implemented by the functional standard (provider). Moreover, it does not show a real hierarchy of users. I would argue that, at least as far as telecommunication systems are concerned, in terms of requirements a system manager is little else than just another type of end-user. A corporate network manager's needs will focus on other aspects of the system than those of the end users, i.e. he will be interested in functionality supporting administrative and operational tasks, but nevertheless will concentrate on functionality rather than strategic issues. Thus, I would further argue that the class of users who make the strategic decisions is completely missing in the above model. These users, who are likely to draw upon advice from system managers, are focussing on their respective organisation's business needs rather than purely technical matters. They establish the class of the 'corporate users'; their requirements are largely dictated by their environment (market power, relations to customers, suppliers and business partners, etc).

Still, using the OSI-RM as a tool for modelling different classes of users is quite helpful. Indeed, we can take the similarities between the hierarchy of user classes and the layers of the OSI-RM even one step further: the three lowest layers of the OSI-RM are generally referred to as being 'communication oriented', that is, they deal solely with the problem of how to transfer the information form the sender to the receiver. In contrast, the topmost three layers are called 'application oriented', as their major task is to present and organise the information in a meaningful way to the user. The functionality of the fourth layer, 'Transport', falls somewhere in between.

We can now identify an analogous three-level hierarchy for standards and users as well (see Figure 2.3.2). The lower three layers are 'standard oriented', they provide a framework within which standard-compliant systems and services can be built. The two upper layers are 'user oriented', a specific technology is not that important at this level; it is more important that it fits into the existing or envisaged environment (primarily for corporate users) and that it provides adequate functionality (primarily for end-users). In between there are the service providers and vendors, who have to deal with both aspects to produce something useful for their customers, and thus have to consider their requirements as well. If we take the abstraction yet another step further we will come to a well-known classification of users that distinguishes between

- users of implementations or services and
- users of standards.

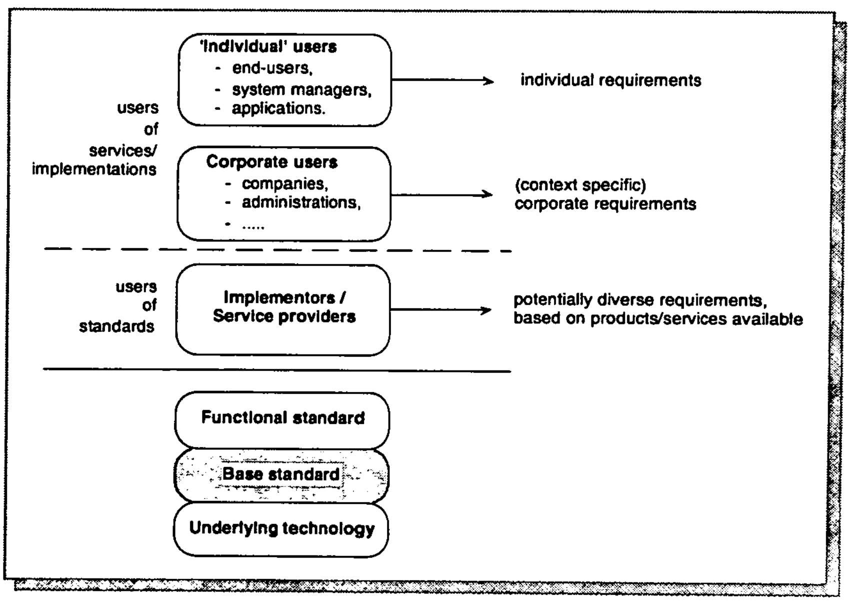

Figure 2.3.2: A Three-Level Hierarchy for Standards and Users

A user of an e-mail *service*, for instance, may be a corporate user (e.g. a company or a government agency), or an actual end-user; it may also be a system administrator or even an application (e.g. EDI)[69]. These groups will each have very different requirements, visibility of which will vary from 'potentially considerable' in case of a

[69] Electronic Data Interchange.

really large corporate user to 'virtually non-existent' for human end-users [Jak 95b]. If services are based on standards specifications, vendors and providers are also users, but of *standards specifications* (as opposed to services). Accordingly, from a standard's point of view, the former category may be referred to as 'indirect' users of standards, as they are typically only employing services based on or around implementations of standards, rather than the standards themselves. In contrast to that, the latter category may be termed 'direct' users of standards, as the products and services they are offering incorporate, and/or are directly based on the standards specifications. Figure 2.3.3 once more depicts these different relations, but from another angle. Looking at a 'user' from yet another angle, we find that several differentiation schemes have been suggested in the literature on innovations and on the social shaping of technology. Typically, these schemes have been based on computing skills. Identified categories include users who develop their own systems, who control development of their systems, data processing professionals, and programmers (see e.g. [Cott 89]). However, not least with the emergence of end-user computing these boundaries have vanished to some extent.

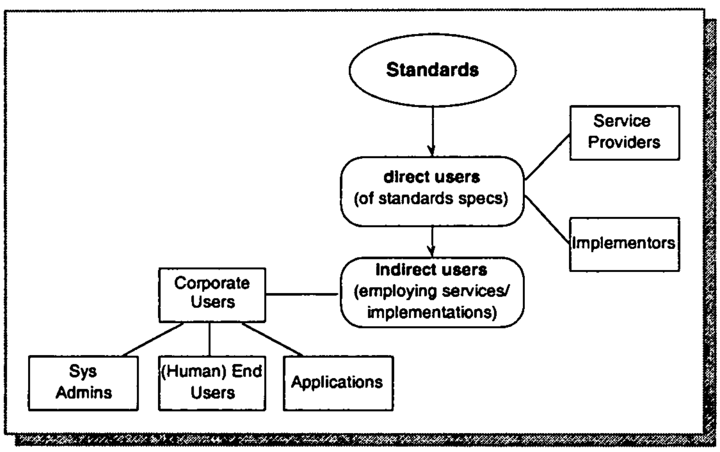

Figure 2.3.3: Categories and Classes of Users

A different classification has been proposed in [Finch 94], based on the variables of organisational power and IT expertise, and distinguishing between in-house IT specialist, non-programming user, functional support personnel, computer-skilled business programmers, and (unskilled) organisational groups. Moreover, a corporate IT department, for instance, may well assume a dual role, acting as a user as regards an external vendor, and being the supplier itself for local end-users or other departments. In any case, and whichever classification is applied, it should be obvious that again 'user' in no way denotes a homogeneous group with similar requirements, expertise and perceptions.

It has already been noted that during the implementation particularly of configurational systems, knowledge regarding technological, organisational and economical problems is distributed among vendors and users; only cooperation and collaboration will yield positive results. In particular, it is the users' task to develop and communicate knowledge of their respective working environment, including organisational aspects as for instance the respective organisational framework, local administrative structures, specific information channels, and characteristics of the work organisation, but also technical information as e.g. existing legacy systems that need to be integrated. It follows from this diversity that representatives of all types of users have to be involved in, and have to contribute their specific knowledge and requirements to, the implementation of a new IT system.

Chapter 3

Research Design

The methodology adopted for the survey is briefly described in this chapter. Section 3.1 outlines the phases of the work, discusses the rationale for the adopted approach and the particularities of the target populations that led to this approach. The actual course of the survey is outlined in section 3.2, where the pros and cons of using e-mail as a medium for collecting information are also discussed, including some lessons learned.

However, before actually looking at the adopted methodology I would like to briefly address the question 'Why look at e-mail?', that is, to review the initial decision to select e-mail for the case studies.

Services facilitating the exchange of messages between users of a mainframe system have been around since the late 1960s. A similar service, this time over a network, was available in the ARPA-Net in the early/mid 1970s. The first e-mail standard specifications, that are still valid today, were the Internet's (then ARPA-Net) RFC 821 (SMTP specification [RFC 82a]) and RFC 822 (text message format [RFC 82b]), published in 1982. The first version of ITU's (then CCITT) recommendations on a 'Message Handling System' were published in 1984, with subsequent versions published in 1988 and 1992/93, respectively.

From these dates it is fairly obvious that electronic mail is a reasonably mature service. On the other hand, it still is a developing service in terms of both, functionality and number of users. Thus, it may be anticipated that considerable experience is available related to its advantages and drawbacks, and that members of the different standardisation work groups have over the years gained considerable knowledge on the service's particularities.

Whilst being a mature service, at the same time there is still a need to discuss e-mail's properties and required functionality given the ongoing trend towards service integration; mail-enabled applications, for instance, will pose new and demanding requirements onto electronic mail services.

3.1 The Research

Given the nature of the research the general methodology to be adopted was straightforward. It encompassed three phases:

- **Preparatory work**
  Particularly including a literature survey.

- **Information collection**
  Data were compiled through interviews and questionnaires.

- **Information analysis**
  The actual evaluation.

Figure 3.1.1 depicts the relation between these phases and the elements of the model of an ideal research process (which does not include the preparatory work, as this is outside the direct scope of a survey).

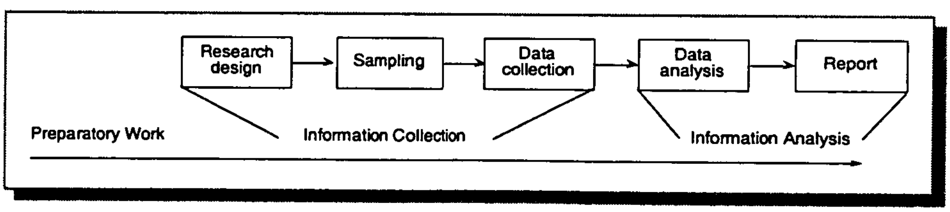

Figure 3.1.1: An Ideal Typical Research Process
(adapted from [Burg 93])

3.1.1 Preparatory Work

A literature study was the obvious starting point. Due to the multidisciplinarity of the work the survey had to cover a variety of different topics, including aspects of standardisation and innovation processes, diffusion of innovation, usability of communication systems, and the technology of electronic messaging systems. The use of bibliographic data bases and World Wide Web search engines yielded a large number of references from very different disciplines such as business studies, social sciences, information systems and data communications.

The survey itself can be subdivided into two phases. Phase one took place during the first months of the work and served to provide a sound basis of knowledge about the different topics on which further work could draw[70]. The second phase inter alia comprised the survey as such, plus a continuing literature scan, and continued until about halfway through year three of the project. The following descriptions refer to this phase.

3.1.2 Information Collection

Complementing the initial general survey a more specialised literature search was undertaken regarding

- usability aspects of IT systems in general and electronic mail in particular,
- dimensions of standardisation,
- adoption and diffusion of innovations,
- functional requirements.

Again, bibliographic databases (primarily INSPEC), WWW search engines, and references from available books and papers were the major tools for this search. The main source of information, however, was a survey covering corporate e-mail users and members of standardisation bodies' committees.

Data Collection

Different alternatives have been identified for conducting research, including case studies, surveys, and experiments ([Burg 93], see Figure 3.1.2).

The nature of the information sought ruled out experiments, and although some 'historical' evidence was of particular interest, this was by no account at the centre of the study. A case study would have been an option, but would have brought with it a

70 Reasonably sound knowledge on communication related topics was already available prior to the start of the work.

number of major practical problems (access to potentially confidential corporate information, accreditation at standards committees etc.), and would have implied a focus on a very limited number of organisations and committees (probably just one). Accordingly, a survey was the approach of choice.

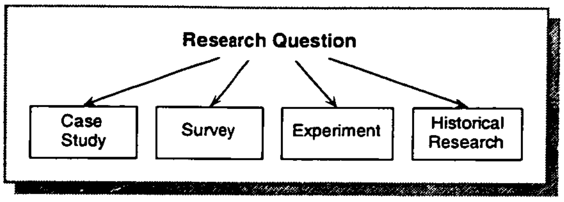

Figure 3.1.2: Data Compilation Techniques
(adapted from [Burg 93])

The choice of the data collection method is directly related inter alia to the characteristics of the sampling frame [Fowl 93]. In this particular case, the survey aimed at a category of people who had to be expected to be extremely busy, with little, if any, time left to spend on interviews. Apart from that, potential respondents were located around the globe; these two points made conducting any form of interview (face-to-face, group, phone) extremely difficult. This left mailed questionnaires as the method of choice.

The general main pros and cons associated with this approach have frequently been cited in the literature (see e.g. [Chis 92], [Fowl 93], [Oppen 92]). The former include low costs of data collection and processing, avoidance of interviewer bias and the possibility to cover a broad geographic area (which was particularly crucial for the problem at hand). On the other hand, the cons include a normally low response rate and the likelihood of a resulting bias, a necessary minimum degree of literacy on the side of the respondents, the lack of control over the order in which questions are answered, and the lack of any interactivity e.g. for probing or to clarify misunderstandings. In particular, it is claimed that open-ended questions are to be avoided [Fowl 93].

However, a closer look at the cons reveals that they do not really hold in this particular case, except for the low response rate. As no statistical significance was strived for, the problem of a potentially biased outcome could be ignored[71]. The required literacy

[71] A degree of bias could have been introduced, for example, through addressees with a particular attitude towards standards setting, or e-mail, being more inclined to respond than others. Whilst I do not feel that this has been the case this possibility would need to be considered if statistical significance were sought.

could be assumed for the target group, and the order in which questions were addressed did not matter at all. Regarding the lack of interactivity, this could be overcome by using e-mail as the transport medium, which not only brought the cost of data collection to virtually zero, but also introduced a convenient and time-efficient parallel communication channel which could be used for questions and clarifications (by both sides). As it turned out, this possibility was used by a number of respondents; in some cases an additional discussion took place regarding some of the aspects in question. Another nice side effect of the electronic distribution of a questionnaire is the lack of any form of space limitation. That is, respondents could use as much space as they felt was required to answer a particular question.

Some respondents commented on the use of open-ended questions in the questionnaire (and on its length), stating that closed questions would have been faster and easier to answer, and thus more desirable. However, as all who made these comments eventually answered the questionnaire, there is no hard evidence that this type of questions had a negative impact on the response rate. A remaining (potentially) problematic point was the difference in importance between the single questions. Some respondents provided extremely detailed answers to relatively minor questions (probably because that information was available electronically and could simply be pasted), and went over important questions comparably sketchy.

Despite the positive aspects that come with the use of a questionnaire it was felt that a number of additional interviews would be beneficial. In particular, a face-to-face discussion could be most helpful for an in-depth discussion of the important issues, and to gain a better understanding of the problems at hand. Moreover, the outcome of these interviews could be used as a starting point for a preliminary analysis which could be done in parallel with the survey.

The Sampling Frames

The ultimate goal of this survey was to compile a number of qualitative studies. In particular, it did not aim at yielding statistically significant data, due to two considerations:

- The accessibility of one group of the prospective respondents (the corporate managers) was deemed far too low to hold the prospect of obtaining more than a (comparably small) number of case studies.

- More important, the nature of the information sought was hardly quantifiable and did not really lend itself to statistical analysis.

The chosen approach has a number of consequences for the survey as such, and the subsequent data analysis. For one, given the small sample size, and the qualitative goal of the research, there was little scope for any statistical analysis of the data. Moreover, the sampling strategy could be held extremely simple. Basically, the survey aimed at two initial populations:

- corporate users of e-mail,
- members of standards setting bodies.

Regarding the former, the sampling frame was established by large, internationally operating members of the two large international messaging associations, i.e. the (European) Electronic Messaging Association (E)EMA[72]. It was assumed that large companies are more likely to be interested in messaging-related issues, as they have an urgent need of seamless global information interchange than e.g. companies operating only within a national or even local environment[73]. It was also felt that membership in (E)EMA expresses a higher than average degree of interest in the subject. The individual prospective interviewees were senior members of IT departments, and almost all of them were responsible for the respective corporate e-mail system. In most cases they were also the representatives of their respective company to (E)EMA. These were considered the most reasonable criteria since they guaranteed adequate technical and organisational knowledge on the part of the respondents. Regarding the latter, the sampling frame comprised of members of the following standards setting committees:

- **ISO/IEC JTC1/SC18**[74]
  This group is responsible for 'Document Processing and Related Communication', which includes electronic messaging.

72 EEMA is the European sister organisation of the American EMA; with the Australian AEMA and JEMA of Japan they aim at establishing WEMA, the World Electronic Messaging Association.

73 As most interviewees asked that their companies remain anonymous, the respective identities will not be revealed. It can be said, however, that they cover a wide range of businesses including, but not limited to chemistry, financial services, oil, aviation, and major government agencies.

74 International Organization for Standardization / International Electrotechnical Commission Joint Technical Committee 1, Sub-committee 18.

- **ITU SG 7**[75]

  This study group is in charge of questions related to 'Data Networks and Open System Communications', again including electronic messaging.

- **ITU SG 8**

  The group addresses questions related to 'Terminals for Telematic Services'.

- **ITU SG 13**

  This group is in charge of the topic are 'General Network Aspects'.

- **ANSI JTC1 TAG**[76]

  This is a high-level strategic advisory group, the primary responsibilities of which are to coordinate the development for JTC 1 level US positions and to coordinate US interests.

- **Messaging-related IETF Working Groups**[77]

  This is the 'standards body' of the Internet. The Working Groups are in charge of different single aspects of the Internet's e-mail system.

The prospective individual respondents were selected from the respective group's senior members, including project editors (responsible for writing up the specifications), chairpersons, and liaisons (responsible for maintaining links between different committees). According to [Spr 93], *"..most committees are directed and driven by a small group of individuals, usually ten percent or fewer..."* and *"In most committee meetings, approximately twenty-five percent of the members are attending for the first time. This is true for meetings per year, year after year."* By limiting the group of prospective respondents to those holding some sort of official mandate, it was hoped to concentrate the efforts on the more experienced and knowledgeable members rather than the large group of relative 'newbies', who are hardly in a position to answer the questions adequately. In case of the IETF, regular participation in the tri-annual IETF-meetings was the major selection criterion.

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[75] International Telecommunications Union Study Group 7.

[76] American National Standards Institute Technical Advisory Group for ISO/IEC JTC 1.

[77] Internet Engineering Task Force; the Working Groups studied were 'Receipt', 'Notary', 'Mixer', 'DRUMS', 'ASID', and 'IDS'.

Questionnaire Design

The nature of the information sought (as discussed above) had a major impact on the design of the questionnaire. Thankfully, by and large it made life easier. For example, the ordering of questions was not that much an issue. Whilst obviously a certain logical structure was necessary (e.g. to avoid switching back and forth between subjects), it did not really matter whether or not questions were answered in the same order they were put. Moreover, the fact that no statistical analysis had to be done rendered subsequent coding unnecessary. Rather, the underlying guiding principle of the questionnaire was to convey as little bias as possible, as it was felt that unanticipated answers were most likely to occur. Taken together, these characteristics suggested the use of open-ended questions[78].

Typically, there appears to be a general agreement in the literature that open questions should be used sparsely (see e.g. [Fowl 93], [Hague 93], [Hoin 89]). The disadvantages of both, open and closed questions can be summarised as follows (adapted from [Oppen 92]):

Open questions	Closed questions
Time-consuming	Loss of spontaneous response
Costly of interviewer time	Bias in answer categories
Potentially unreliable coding	Sometimes too crude
Responding requires more effort	May irritate respondent

Table 3.1.1: Disadvantages of Open and Closed Questions

It turns out that the relevant disadvantages associated with open questions boil down to 'time consuming'. Whilst this is an issue, which was in fact commented on negatively by some respondents, it was felt that this was outweighed by the benefit of obtaining unbiased information. Accordingly, only open questions were put in the questionnaires.

As two populations were to be covered (corporate representatives and standards committee members), two different questionnaires were required. The questionnaire designed for the former was made up of four parts, entitled 'general background', 'e-

[78] 'Open-ended' or 'open' questions to not provide a choice of pre-defined replies (as 'closed' questions do), but give the respondent the opportunity to put down his/her thoughts and ideas in some detail.

mail', 'directory', and 'standardisation'; the numbers of questions per part were three, twenty, fourteen and twelve, respectively. The topics addressed included:

- general expectations on, and experiences with electronic messaging services,
- introduction strategies,
- end-user related issues,
- envisaged or planned future developments,
- functional shortcomings of the systems used, if any, and how they were overcome, if at all,
- attitudes towards participation in standards committees.

The questionnaire sent to standardisation committee members was not subdivided, comprised twenty-one questions and asked for perceptions on

- the process in general,
- pitfalls of the standardisation process and envisaged enhancements,
- problems and benefits of increased user participation.

As face-to-face interviews had also been planned the same questionnaire was used for both activities. This enabled direct comparison and common analysis of the information.

3.2 The Survey

As mentioned above, the survey was made up from an e-mailed questionnaire (distributed to company representatives and senior standards committee members), complemented by a number of face-to-face interviews (with company representatives).

Piloting

Virtually all aspects of a survey can, and indeed should normally be piloted. Yet, again due to the specific circumstances of this particular survey, some piloting could be omitted. As e-mail was used to distribute the questionnaire, the relevance of layout issues was virtually zero, since text-only messages were sent to avoid any technical (i.e. conversion) problems. There was little need for a sophisticated layout anyway as only open-ended questions were asked. As the order in which questions were answered was almost arbitrary, the questionnaire's structure did not play a major role either[79]. On the other hand, the compilation of questions obviously had to be piloted, to make sure that they actually covered the interesting topics. Likewise, non-ambiguous wording had to be ensured as well. As the compiled questions were supposed to double as questionnaire and as interview guideline it was deemed sufficient to limit the piloting efforts to interviews, where immediate feedback on perceived inaccuracies and flaws could be obtained.

Thus, six trial interviews were conducted to test the questionnaire for completeness and to identify inadequacies. The set of questions saw major modifications as a result of the first three interviews, whereas subsequently it remained largely stable[80].

3.2.1 Face-to-Face Interviews

To overcome (at least in part) the problems associated with face-to-face interviews (same time - same place, scattered geographic locations, high associated costs etc.) it was decided to try and conduct all interviews in the same area, during a reasonably short period of time. Sixteen interviews were scheduled for a two-week period, with all interviewees located in or near London. As three appointments were cancelled at very short notice, a total of thirteen interviews remained.

E-mail was used to establish a first contact with prospective interviewees, which were selected from the EEMA Membership Directory. Background information detailing the scope and the envisaged kind of outcome of the study was provided in the cover letter. In exchange for their efforts, electronic copies of the thesis were offered to those interested. In case of positive replies, a date was arranged via e-mail and the questionnaire was sent to give the respondent a better idea about what to expect. Alternatively, in cases where no response was received, phone contact was established. The latter yielded a far higher percentage of agreed interviews; indeed, only three interviewees could be done through e-mail contact alone. Again, a date was arranged with those who were prepared to do an interview, and the questionnaire was sent to them (again via e-mail).

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79 This holds although there was a logical structure underlying the given sequence. The questions are clearly interrelated and based on each other, but not to a degree that would clearly favour a particular order of answering.

80 It should be mentioned, though, that some respondents took the particularly interesting sample topics, which were included in the wording of some questions to better convey what they were aiming at, as the sole issues of interest. While possibly some information was lost here, this was not that bad because these were indeed the most interesting topics.

Prior to the actual interview an introduction was once more given, explaning purpose and agenda of the study in greater detail. Following the interview, a summary of the results obtained so far was given, to provide the respondents at least with some sort of immediate 'return on investment'.

The nature of the topics to be discussed and the characteristic of the interviewees (i.e. typically very knowledgeable but extremely busy IT-professionals and managers) lent itself to conducting only a comparatively small number of depth interviews. Semi-structured depth interviews were conducted, that is, a catalogue of open ended questions served as a guideline through the interviews. Depth interviews allow a discussion to run more freely, and to address issues that rise spontaneously, or to omit topics that may be irrelevant in particular cases [Hoin 89]. In fact, it turned out that if people were interested in the topics for one reason or another, they were almost always willing to actually spend a considerable amount of (both, working and spare) time on an interview, in many cases much more than initially granted. If not, they wouldn't spend any time at all on it. Finally, given the restrictions of time, budget, and in fact, the number of suitable interviewees, a large scale survey would have been next to impossible.

This part of the survey comprised ten face-to-face interviews with representatives of companies from very different sectors, including but not limited to, finance, information brokering, transport, and petro-chemicals, all headquartered in London and its vicinity. Three additional interviews were conducted with representatives of international e-mail service providers. In these cases the interviewees were responsible for commercial messaging customers. The topics covered were almost identical to the above, but this time they referred to the respective customers rather than to the service provider companies. Typically, interviews lasted between one and three hours. In addition to this information obtained from nine similar interviews conducted earlier [EEMA 94a], [EEMA 94b] were used.

Extensive notes were taken during the interviews, which were also taped. Extended summaries of the interviews, based on notes and recordings, were produced the same day. These were no full transcripts, largely due to time constraints. The tapes were also used subsequently to clarify ambiguities of the summaries, to recall certain details that were not included in the summaries, and to extract typical quotes.

3.2.2 Questionnaires

Doing face-to-face interviews is a costly exercise in terms of both, time and money. Therefore, and true to the motto 'practice what you preach' they were complemented by questionnaires being distributed via e-mail to both corporate representatives and members of standardisation bodies.

As for the face-to-face interviews, e-mail was used to establish the initial contact. Again a cover letter was provided, giving necessary background information on the scope and the envisaged kind of outcome of the study. The questionnaire was included as well. Again, electronic copies of the thesis were offered to those interested.

A reminder was sent to every addressee who had not responded to the first mail. However, it did not increase the response rate very much (this holds particularly for the corporate representatives). A total of twenty responses from corporate representatives were received, representing a response rate of 4 %. Regarding the committee members, the response rate was at 19 % (69 responses in total).

3.2.3 E-Mail as a Medium for Conducting Surveys

This section discusses the pros and cons of e-mail as a medium for conducting research (see also [Chad 96b]), comparing it with the respective benefits and drawbacks of the 'classical' survey media, i.e. interviews done either face-to-face or via the telephone, and questionnaires distributed through postal services.

At first glance e-mail lends itself to surveys; its advantages are striking and numerous. For instance, e-mail allows simple and efficient distribution of questionnaires to an ever increasing number of potential interviewees, whose addresses can be obtained from business cards or, maybe more fittingly, through the Internet using WWW browsers, directory services or Newsgroups. Moreover, there is a vast number of distribution lists (DLs); all subscribers to such a list can be reached through just one message. Distribution lists - like Newsgroups - have the additional advantage that a higher than average interest in the topic can be concluded from subscription to a certain DL or Newsgroup, and thus a good response rate might be expected.

E-mail also supports some form of limited interactive dialogue (if neither the communication partners nor the interconnecting network are too busy, that is). Last not least, 'Practice what you preach'; surveys on electronic messaging should also be conducted primarily via e-mail.

Table 3.2.1 shows the time/place matrix of the three different survey media. The fact that e-mail allows for different time / different place represents its major advantage; surveys via e-mail allow both, the respondent and the interviewer, to allocate the time needed for the survey according to their schedules rather than having to allocate some hours for a face-to-face interview in advance - an exercise that involves considerable problems.

	same time	different time
same place	face-to-face	--
different places	telephone, (e-mail)	post, e-mail

Table 3.2.1: Time/Place Matrix for Different Survey Media

To actually use e-mail for doing surveys, access to at least one e-mail service for both, interviewer and prospective respondent, is a sine-qua-non. In principal, this limits the overall number of accessible respondents considerably, with the additional disadvantage of favouring certain groups of the population (e.g. well educated males), whilst discriminating against others (e.g. not well-off females). On a similar level, certain technical knowledge is required to use e-mail properly. However, these were no problems at all during this particular study, which aimed at a very e-mail literate group of respondents.

Besides these rather general issues, some more specific concerns need to be addressed as well. For instance, not everyone has access to an e-mail system at work, although the number of corporate mailboxes is steadily increasing[81]. This holds especially if people need to be accessed from outside their organisation, which may well have an internal network in place, but does not provide connections to the outside world. With the increasing use of corporate e-mail systems, and the continuing trend towards more openness in corporate e-mail systems, significance of this point is decreasing. However, it still poses certain and sometimes annoying limitations on the use of e-mail for doing surveys.

Basically the same holds for the difficulty of obtaining addresses. Although e-mail addresses are not always given on business cards, even if they are available, in some cases these addresses can be obtained (electronically) from other sources, like e.g. the

[81] Please note that this study did not look at private users of e-mail.

World Wide Web, or sometimes through corporate or public directories. It should, however, be noted that the likelihood of a letter being correctly delivered even in case of an incomplete address is much higher than it is for e-mail, which does not tolerate incomplete or inaccurate addresses.

This situation is worsened by the fact that many organisations use rather cryptic address parts which tend to make guessing a correct address (e.g. from known person's and organisation's name) next to impossible. Still worse, typing such cryptic addresses is highly error-prone, as in many cases they do not have any intuitively clear meaning. This holds particularly for X.400 addresses [ITU 92c]. Inadequate interoperation between X.400 and Internet-mail, caused for instance by not standard-compliant or faulty implemented gateways, also adds to the dilemma.

The really maddening bit, however, is the surprisingly high number of incomplete, incorrect or invalid addresses distributed via printed media (with the exception of business cards), which are still the major source of information on e-mail addresses. The percentage of such addresses, each of which resulting in an error message delivered to the sender of the original message, may well exceed 50%. Put together, these points represent an annoying obstacle to the use of e-mail.

To compensate those disadvantages, using e-mail for surveys will yield savings in terms of both, time and money. Whilst the latter does not appear as being that important, costs for the distribution of several hundred questionnaires via air mail to recipients located all over Europe, North America, Australia and Japan may well prove prohibitive. In contrast to that, distribution via e-mail comes for free (at least if you are with a university).

Another benefit that can be gained through the use of e-mail is the added level of - although restricted - interactivity. This could be exploited in a number of cases, either to clarify questions, or, more frequently and more important, to ask for more detailed information on certain, particularly interesting topics. It definitely contributed to a more concise outcome of the study.

Time saving gained through using e-mail can be enormous. With delivery times of up to three weeks to and from the US, for example, conducting such a survey would last almost prohibitively long. Moreover, the - although limited - interactive nature of e-mail provides for a simple way of asking for clarification on answers which are not entirely clear or complete.

Finally, in very many cases it is easier and more convenient for the interviewee to fill in the questionnaire using a word processor and to respond through a simple 'reply' rather than filling it in by hand. On the other hand, questionnaires in electronic form make post-processing for the interviewer much easier. Table 3.2.2 summarises the major pros and cons that may be associated with the use of electronic mail as a medium for conducting surveys.

PROs	CONs
different time, different place	access to e-mail for interviewer and respondent is a pre-requisite
major time savings	technical expertise needed to handle e-mail system
considerable cost reductions	limits number of potential respondents
suits schedules better	may be difficult to obtain addresses
no geographical limitations	possibility of low response rate
responses available in electronic (i.e. processable) form	limited interaction (compared to interview)
additional level of interactivity (compared to normal mail)	

Table 3.2.2: The Pros and Cons of E-Mail as a Medium for Doing Surveys

To recapitulate: the convenience of a cheap medium, which allows reaching large groups of potential respondents via just one message, and which supports post-processing of the results obtained, outweighs the problems related to obtaining valid addresses which, on the other hand. must not be underrated. It should, however, be noted that all potential interviewees for this study had access to an e-mail system. For quite some time to come this will be the exception rather than the rule. Any generalisations of the above remarks must therefore be considered with great care.

3.2.4 Some Lessons Learned

After having originated some 2,000 e-mails during the course of the study, some lessons have been learned - in addition to those already touched on above - what to do and what to avoid if e-mail is to be used for surveys. These include

- **Don't be frustrated by 'Non-delivery notifications'**
  Be prepared that about fifty percent of the messages delivered will be returned due to incomplete or invalid addresses, or thanks to typos.

- **Refrain from home-made distribution lists**
  Use of lengthy private customised distribution lists may annoy postmasters, as processing messages addressed to such lists tend to block nodes, triggering angry responses from system administrators.

- **Observe 'netiquette'**
  If Newsgroups or distribution list are targeted, the moderator or owner should be contacted in advance to make sure that the survey is considered appropriate for the scope of the respective group or list.

- **Address personally**
  Unlike findings from surveys using postal services (as reported e.g. in [Hoin 89]), e-mails addressed to 'Dear Sir, Dear Madam' yielded a response rate frustratingly close to zero. This happened several times when addressing the members of a distribution list or subscribers to a newsgroup. Whilst this again should not be generalised, it is safe to say that addressees receiving tens or even hundreds of e-mails per day will be put-off by letters which are not personalised.

Another observation, related to the last point, is that trying to make appointments for interviews via e-mail does not seem to be a good idea. Apparently, it is far easier to ignore an e-mail than it is to ignore someone who calls on the phone. In fact, very few people reacted to a request for an appointment, whereas the very same request expressed via phone almost always yielded a positive response. After all, compared to face-to-face meetings and phone calls, e-mail is a very impersonal medium.

Chapter 4

Standardisation Bodies and Messaging Standards

This chapter firstly describes those standardisation bodies - and their procedures - represented in this study (through some of their senior committee members) in section 4.1. Subsequently, section 4.2 will introduce the two messaging standards around which the considerations presented in this thesis are centered, i.e. the X.400 and X.500 series of recommendations on electronic mail and the directory service, respectively.

4.1 Standardisation Bodies and Their Procedures

This section will first briefly introduce the international standards setting bodies represented in this thesis[82], followed by descriptions of their respective procedures.

4.1.1 The International Organization for Standardization (ISO)

The International Organization for Standardization[83] (ISO) is a global, non-governmental federation of national standards bodies from about 120 countries. ISO was established in 1947, with the mission *"to promote the development of*

82 Please note that ANSI JTC1 TAG has not been included in this chapter for two reasons: the procedures of ANSI itself (as the US representative to ISO/IEC JTC1) are very similar to those adopted by ISO. JTC1 TAG is very much a management group (as opposed to the technical groups). While the single members possess extensive experience from former work with technical groups, which makes their comments most valuable, the committee as such is of little interest, as it is far removed from the work of the technical committees I am interested in.

83 'ISO' is not an acronym, but a word derived from the Greek word 'isos', meaning 'equal'.

standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity." [ISO 95f]. Prior to that, standardisation was done under the auspices of either the International Electrotechnical Commission (IEC), created in 1906, in the electrotechnical field, or by the International Federation of the National Standardizing Associations (ISA), established in 1926.

Following the break in standards activities caused by World War II, ISO was founded by twenty-five countries. Its work commenced in 1947, with the first standard published in 1951.

Membership in ISO is on a per-country basis, with one organisation - typically the respective national standards body - representing its country. There are full members, correspondent members (which do not actively participate, but are kept fully informed), and subscriber members which normally represent those countries that cannot afford one of the other categories. Depending on a full member country's interests its representative may decide to become a P(articipating)-member or an O(bserving)-member in a committee, or no member at all. P-members participate actively in the work, with an obligation to vote on all questions formally submitted for voting within the technical committee or subcommittee, and, whenever possible, to participate in meetings. O-members follow the work as an observer, and therefore receive committee documents and have the right to submit comments and to attend meetings (but not to vote).

The operations of ISO are governed by the Council consisting of the principal officers and eighteen elected member bodies. Inter alia, it appoints the twelve members of the Technical Management Board, and the Chairmen of the policy development committees. It also decides on the annual budget of the Central Secretariat. The Officers and delegates nominated by the member bodies constitute the General Assembly. Its tasks include actions relating to the ISO annual report and the ISO multi-year strategic plan with its financial implications. It may also establish policy development committees. The Technical Management Board is in charge of all aspects related to the technical work. Among others, it establishes and dissolves Technical Committees (TCs), allocates their secretariats and appoints their chairpersons, handles the technical coordination between ISO TCs and their respective counterparts within other organisations, and acts as the 'court of appeal' against committee decisions. It also appoints Technical Advisory Groups if expert advice on particular areas is needed. Figure 4.1.1 shows the general structure.

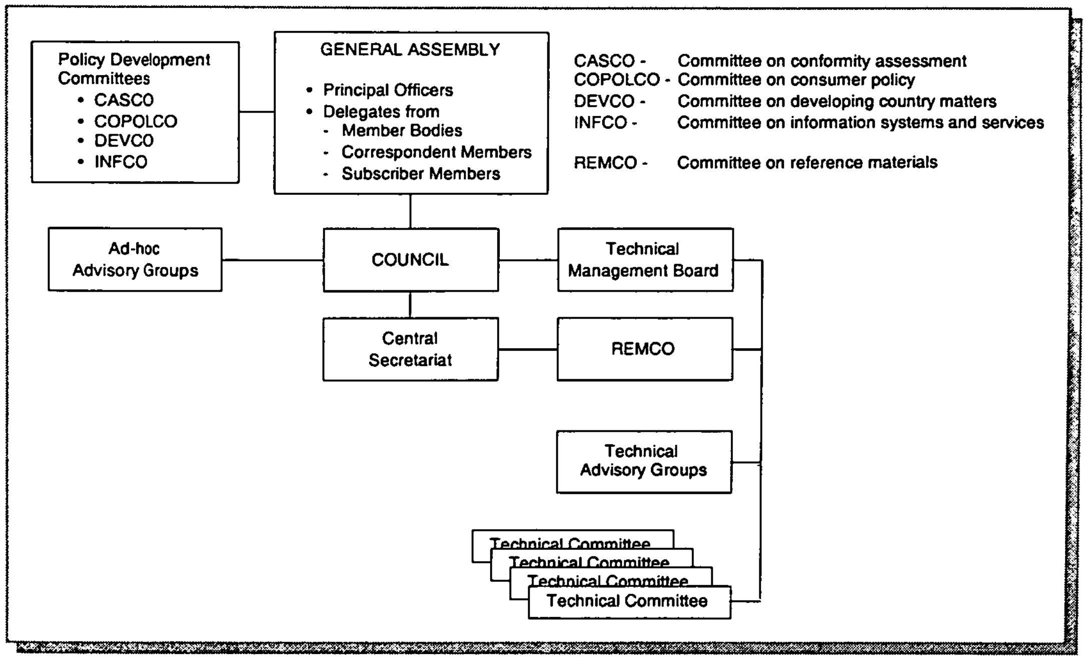

Figure 4.1.1: ISO Structure
[based on ISO 95h]

The actual standardisation work is almost fully decentralised, and performed in 214 TCs and their respective Sub-committees (SC) and Working Groups (WG), with a total number of about 2,700 [ISO 95f]. Participants come from the respective national member bodies, which are also in charge of providing secretarial services for the committees and groups. In general, participation within any TC or SC is open to every national member body and to all A-liaisons (as e.g. ITU-T Study Groups). Development and revision of standards are carried out as 'projects' within an committee. Typically, a project is assigned to a Working Group (WG) comprised of individually appointed experts. It should be noted that *"The experts act in a personal capacity and not as the official representatives of the P-member or A-liaison organisation by which they have been appointed."* [ISO 95a]. ISO itself - being very much a meta-organisation - primarily provides for a central coordination entity, does the final editing of documents prior to publication, and maintains an overall schedule.

In the following the process and procedures governing ISO's standards setting process are described in some more detail, since largely similar rules have been adopted by almost all national and regional private sector standards setting organisations.

The 1995 revision of the ISO/IEC Directives [ISO 95a] specifies the accepted procedures for developing and approving International Standards. The following is a brief outline of the seven-stage development process of an international standard [ISO 95f]:

- **Preliminary Stage (0)**
  During this stage preliminary work items are addressed, covering for instance emerging technologies that have not yet reached a sufficiently mature status for progressing to other stages.

- **Proposal Stage (1)**
  Voting members ballot on the creation of a new standards project.
  The first step in the development of an international standard is to confirm that this particular standard is needed. A new work item proposal (NP) is submitted for vote by the members of the relevant TC/SC to determine the inclusion of the work item in the programme of work. The proposal is accepted if a majority of the P-members of the TC/SC votes in favour and at least five P-members declare their commitment to actively participate in the project. At this stage a project leader responsible for the work item is normally appointed.

- **Preparatory Stage (2)**
  Project Leader manages the development of a Working Draft.
  Usually, a working group of experts is set up by the TC/SC for the preparation of a working draft. Successive working drafts may be considered until the working group is satisfied that it has developed the best technical solution to the problem being addressed. At this stage, the draft is forwarded to the working group's parent committee for the consensus-building phase.

- **Committee Stage (3)**
  Consensus is achieved on a Committee Draft.
  As soon as a first committee draft is available, it is registered by ISO's Central Secretariat. It is distributed for comments from and, if required, voting by the P-members of the TC/SC. Again it may be necessary to consider successive committee drafts until consensus is reached. Once consensus has been attained, the text is finalised for submission as a Draft International Standard (DIS).

- **Enquiry Stage (4)**
  National bodies vote (and comment) on a DIS.
  The DIS is circulated to all ISO member bodies for voting and comment. It is approved for submission as a Final Draft International Standard (FDIS) if a two-thirds majority of the P-members of the TC/SC are in favour and not more than one-quarter of the total number of votes are negative. Otherwise, the text is returned to the originating TC/SC for further study. In this case a revised document will again be circulated for voting and comment as a DIS.

- **Approval Stage (5)**
  Yes/no vote on Final Draft International Standard (FDIS).
  The FDIS is circulated to all ISO member bodies for a final Yes/No vote. If technical comments are received during this period, they are no longer considered, but registered for consideration during a future revision of the International Standard (IS). The majority of votes required for approval is the same as above. If these criteria are not met, the standard is referred back to the originating TC/SC for reconsideration in the light of the technical reasons submitted in support of the negative votes received.

- **Publication Stage (6)**
  ISO publishes the International Standard.
  Once an FDIS has been approved, only minor editorial changes, if and where necessary, are introduced into the final text. The final text is sent to the Central Secretariat which publishes the IS.

Target dates have been established for stages two through six. If these dates are not met by a project it may be cancelled unless suitable justification for the delay can be provided by the secretariat in charge. Target dates are:

- six months until Working Draft status,
- two years until Committee Draft status,
- three years until Final Draft International Standard status.

Table 4.1.1 once more summarises the different stages and the respective outcomes.

Stage #	Project stage name	Associated document	Abbrev.
0	Preliminary stage	Preliminary work item	PWI
1	Proposal stage	New work item proposal	NP
2	Preparatory stage	Working draft(s)	WD
3	Committee stage	Committee draft(s)	CD
4	Enquiry stage	Draft International Standard	DIS
5	Approval stage	Final DIS	FDIS
6	Publication stage	International Standard	IS

Table 4.1.1: Project Stages and Associated Documents

In case of technical errors or ambiguities, or outdated information included in the document detected after publication, a Technical Corrigendum will be produced, or the corrections may be incorporated into a new edition of the standard. Alternatively, an Amendment modifies and/or adds information. Amendments too follow the procedures for a new project.

If a document with a certain degree of maturity is available at the start of a standardisation project, for example a standard developed by a national standards organisation, it is possible to omit certain stages. In the so-called 'Fast track procedure', a document is submitted directly for approval as a DIS to the ISO member bodies (stage 4). If the document has been developed by an international standardising body recognised by the ISO Council (as e.g. ITU-T), it can be submitted for approval as an FDIS (stage 5), without passing through the previous stages.

Following publication a standard will be subject to reviews in five-year intervals by the P-members of the TC/SC. Outcome of this review decides whether the standard is confirmed, revised or withdrawn. A document to be revised will be dealt with like a new project and will have to go through stages two through six.

JTC 1

To adequately deal with all aspects of information technology ISO and IEC jointly established JTC1[84] in 1986. Today, 25 countries actively participate in the work of JTC1 (P-members), another 35 are O-members. The total number of ISO (draft)

[84] Joint Technical Committee One.

standards under the direct responsibility of JTC1 and its SCs is around 300. Figure 4.1.2 shows the position of JTC 1 in relation to its parent organisations ISO and IEC.

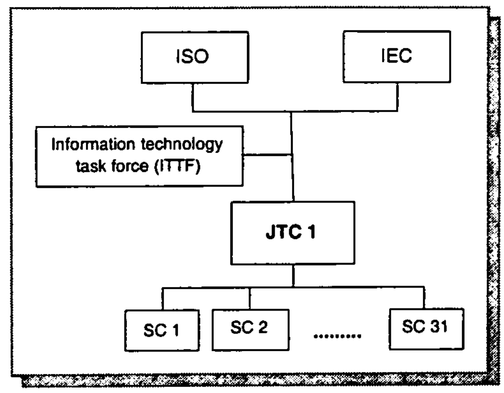

Figure 4.1.2: JTC 1 Organisational Chart

JTC 1 has developed its own set of procedures and guidelines, taking into account the special circumstances of, and requirements on IT standardisation [ISO 95b]. The rules specifying the steps towards an international standard differ slightly from those adopted by the remainder of ISO. For one, they comprise only six stages, basically combining Enquiry and Approval stages into one. The most important difference, however, has been the implementation of a Transposition Procedure for Publicly Available Specifications (PAS). Based on the fast track procedure, this is an even more extensive policy for proprietary specifications to be transposed into international standards [ISO 95c], [ISO 95d]. As with the fast track procedure, this reflects the recognised need for a speed-up of the standards setting process, and even more so, the fact that considerable expertise - and almost readily usable specifications - may be available from companies or consortia. The procedure works as follows:

An organisation wishing to have one of its proprietary specifications transposed into an international standard (termed the 'PAS originator') first applies for recognition as a 'PAS-Submitter' to the JTC 1 secretariat. This application includes information on the specifications to be submitted and on the PAS submitter. Upon approval, the PAS submitter gains the right to submit specifications for an initial period of two years. The remainder of the procedure follows the fast track procedure as described above. A set of criteria has been developed by which the submitted document will be judged regarding quality, consensus and alignment.

4.1.2 The International Telecommunication Union (ITU)

The International Telegraph Union, the predecessor of the ITU, was set up as a treaty organisation in 1865 by twenty European countries. At the same time, the first International Telegraph Convention was signed.

Following the invention of the telephone in 1876, the Telegraph Union began to cover international legislation in this area as well. The invention of wireless telegraphy in 1896 triggered the initiation of the first International Radiotelegraph Conference, held in 1906. This was the first Plenipotentiary Conference through which the work of the Union - and later of ITU - has since been directed. The International Telephone Consultative Committee (CCIF) was set up in 1924, followed by the establishment of the International Telegraph Consultative Committee (CCIT) in 1925, and in 1927 the International Radio Consultative Committee (CCIR) was founded. In 1934, the Union's name was changed into 'International Telecommunication Union' (ITU), which became a specialised agency of the United Nations in 1947. The International Telephone and Telegraph Consultative Committee (CCITT) was founded in 1956, through the merger of the CCIT and the CCIF.

In an attempt to adapt to the more complex and, particularly, more competitive environment it was working in the ITU was restructured in 1992. According to article 7 of the ITU Constitution [ITU 93a], the Union comprises of (see also Figure 4.1.3):

- the Plenipotentiary Conference, which is its supreme organ,
- the Council, which acts on behalf of the Plenipotentiary Conference,
- World Conferences on International Telecommunications,
- the General Secretariat, in charge of administrative and organisational tasks,
- Telecommunication Standardization (ITU-T; formerly CCITT),
- Radiocommunication (ITU-R; formerly CCIR; the standards setting activities have been moved to ITU-T),
- Telecommunication Development (ITU-D).

Fundamental policy and organisational decisions as well as long term strategic resolutions are made at 'Plenipotentiary Conferences' which are convened every four years. Between two such conferences the ITU Council, which is composed of forty-six members, is in charge of monitoring the implementation of decisions taken. It also considers policy and strategic issues, and is generally conducting the day-to-day business. If necessary, telecommunications regulations are revised at a 'World Conference on International Telecommunications'.

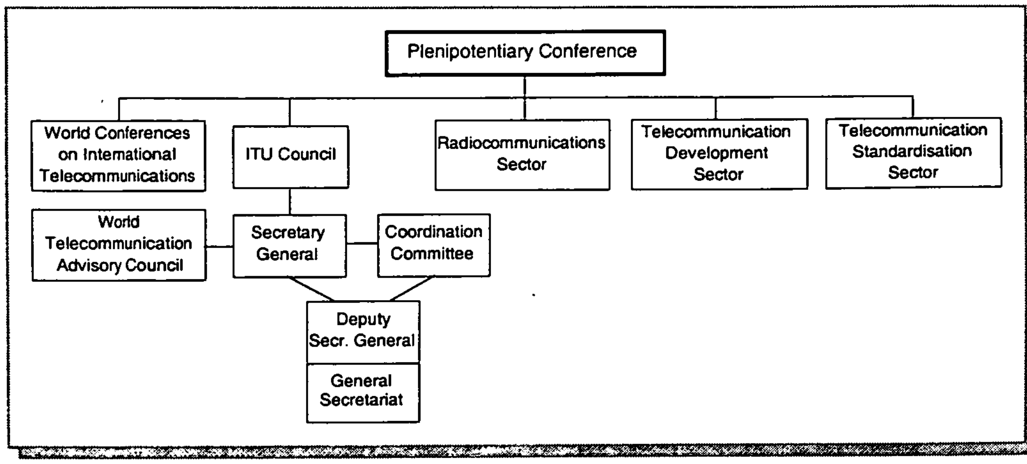

Figure 4.1.3: The Structure of the ITU

Early 1996, the ITU comprised of 185 Member States and 363 members (scientific and industrial companies, public and private operators, broadcasters, regional/international organisations) in the three sectors. However, the right to vote is restricted to one representative per Member Country, i.e. almost exclusively to the respective national PTTs[85] or, for some countries, to one of the respective national Recognised Operating Agencies (ROAs, e.g. AT&T in the US). Other companies, notably those referred to as Scientific or Industrial Organisations (SIOs), need to be approved by their respective governments, and only have a right to participate and to contribute to the technical work, but are not allowed to vote.

As another result of the increasingly competitive standardisation environment the goals identified in the ITU strategy document [ITU 94a] include adoption of a market-oriented approach to standardisation, among others through delivery of high-quality products (i.e. recommendations) on time and enhancement of participation and involvement by non-administration entities and organisations.

The Telecommunication Standardization Sector (ITU-T)

All technical and organisational work on standardisation is done within ITU-T, which since 1993 operates through ([ITU 93b]; see also Figure 4.1.4):

85 Post, Telegraph and Telephone administration.

- World Telecommunication Standardization Conferences (WTSC) supported by study groups (legislative),
- an Advisory Group on Standardization (strategic advice) and,
- a Standardization Bureau (administrative).

In analogy to the organisational structure of its parent organisation, ITU-T convenes quadrennial 'World Telecommunication Standardization Conferences' as the top-level decision making organisational institution. They approve, modify or reject proposed draft standards (called 'Recommendations' because of their voluntary character) and approve the technical programme of work, which is subdivided into 'Questions', each of which identifies a rather broad work area.

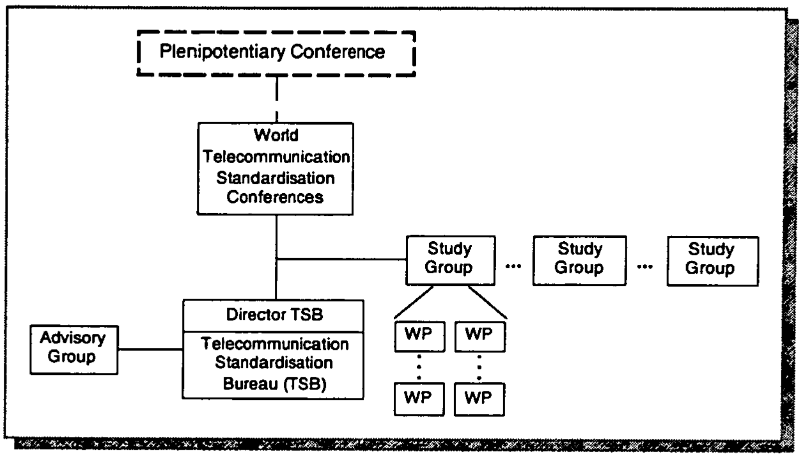

Figure 4.1.4: ITU-T Organisation

Again as a result of the restructuring exercise Advisory Groups have been established in ITU-T to:

- review priorities and strategies for activities,
- review progress in the implementation of the work programme,
- provide guidelines for the work of study groups,
- recommend measures, inter alia, to foster cooperation and coordination with other standards bodies.

Day-to-day management is performed by the 'Telecommunication Standardization Bureau' (TSB), which organises and coordinates the work of the sector.

The technical work is done in Study Groups (SGs). These are groups of experts from administrations, the public sector, and private organisations. Membership in study groups is limited to representatives of ITU Members. During the current study period (1997 - 2000), fourteen Study Groups (SGs) are active.

SGs are established by the WTSC which also assigns to them the Questions to be studied. That is, rather than addressing a specific topic to be standardised a SG has to deal with pretty broad Questions each of which may cover very diverse topics. The SGs produce draft recommendations within the scope of the questions assigned to them. These are to be approved by a qualified majority of members of the WTSC. Until 1992, this resulted in the well-known four-years study periods. Following the reorganisation of ITU in 1992, in order to speed up and streamline the process, this strict formalism was abandoned; recommendations may now be decided upon through correspondence between two Conferences in which case 70% of the replies received must indicate approval. Similarly, new Questions can be identified between WTSCs.

Both, representatives of member countries (typically from the PTT or an equivalent organisation) and other organisational members (e.g. from SIOs) may participate in the technical work at SG level and submit contributions. However, representatives of organisational members need to be approved by their respective member country. Every SG is headed by a chairman and a (possibly several) vice-chairman, who are appointed by the WTSC, based on their technical and management skills.

To adequately deal with this variety of topics an SG typically needs to be further subdivided into Working Parties (WPs, see Figure 4.1.4), and possibly sub-working parties. Like Study Groups WPs are headed by chairpersons, who are appointed by the chairperson of the parent SG. In addition, Rapporteurs may be appointed by the chairperson in charge to perform in-depth studies of specific technical questions. Rapporteurs play a crucial role in the development phase of a draft recommendation in that they are not only in charge of solving technical problems, but may also act as Liaison Rapporteurs, that is, they are the interfaces between SGs or WPs working on related subjects, and the contact points for liaison with external groups. Rapporteur group meetings are convened to discuss technical details and to ensure that overlap between activities performed in different groups is minimised.

ITU-T has recognisesd that communication with consortia and fora is essential in order to produce high-quality specifications based on real user needs. Formal communication has been established with a number of such organisations, including the ATM-Forum, the Network Management Forum, and the Object Management Group [ITU 97].

4.1.3 The Internet Engineering Task Force (IETF)

The Internet's standardisation process has changed over the years, from very informal ad-hoc implementations driven by a few enthusiastic people to a reasonably - some would say overly - formal procedure today. There are, however, quite a few things that survived this transformation, most notably the openly available Request for Comments (RFC) series of documents, which provides a forum for discussion on new protocols, mechanisms, and ideas. RFCs are not necessarily related to standardisation, but approved Internet standards remain part of this series as well.

The process has been designed to provide quick solutions to immediate problems. Obviously, this approach tends to produce specifications with possibly a somewhat limited scope. This is in clear contrast to the strategy adopted, for instance, by ISO. However, extension mechanisms exist in most specifications, to enable integration of further developments.

Figure 4.1.5 shows the entities involved in the IETF standards setting process (see also [RFC 96b]. The Internet Society (ISOC) was established in 1991 as an international organisation to oversee growth and evolution of the Internet and the social, political, and technical issues that arise from its use. It is managed by a Board of Trustees elected by the worldwide membership. Internet standardisation is an activity under the auspices of the ISOC. The need for this professional control unit originated in the Internet's expanding commercial market and international scope.

The Internet Architecture Board (IAB), the former top management entity, was placed under the ISOC with the responsibility for *".. oversight of the architecture of the worldwide multi-protocol Internet"* [Crock 93]. The IAB is also responsible for approving appointments to the Internet Engineering Steering Group (IESG). The IAB provides architectural oversight and does the final technical review of Internet standards, and provide leadership in the IETF, based on skills and years of experience [RFC 94a].

The IESG in turn is responsible for technical management of the Internet Research Task Force (IRTF) and the Internet Engineering Task Force (IETF). Members of the IESG include the IETF chair and the directors of the different IETF technical areas. Its responsibilities include the management of the standards process, and the final approval of specifications as Internet Standards.

The IRTF is in charge of considering long-term developments, work on topics which are considered as too premature or too uncertain for immediate standardisation work. However, the outcome of the IRTF activities may well lead to standardisation efforts.

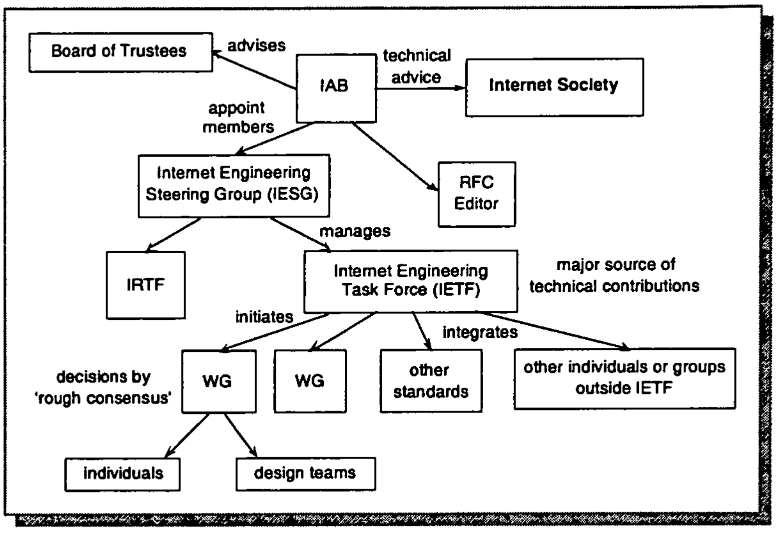

Figure 4.1.5: Entities Involved in the Internet' Standardisation Process

The actual technical standardisation work is done within the IETF Working Groups (WGs) who are chartered by the IESG. They are the primary mechanism for development of IETF specifications. A working group may be established at the initiative of an Area Director (AD) or it may be initiated by an individual or group of individuals. The goals of the standards process, as pursued within the WGs are [RFC 96a]:

- technical excellence,
- prior implementation and testing,
- clear, short, and easily understandable documentation,
- openness and fairness,
- timeliness.

The IETF working groups are grouped into areas, and managed by ADs. The ADs are members of the IESG. Membership of WGs is open to all interested individuals; with e-mail distribution lists being used as the major communication medium. In fact, an IETF 'member' is someone whose address appears on one of the IETF's distribution lists. In addition, there are three annual IETF meetings. A rough consensus of all WG members is required before a specification can proceed on the standards track, which is another major difference to the approaches adopted by ISO or ITU. In particular, there is no formal voting procedure. If consensus cannot be achieved, the IESG will undertake to solve the problem. If this fails, the IAB will be the final authority for an appeal and may, for instance, establish a new working group to consider the matter.

Typically, a standards action is initiated by a work group having produced a specification they consider as satisfactory. The document is made available for comments as an Internet Draft for a certain time, and is subsequently submitted to the IESG. If a specification is found to be of sufficient importance to the Internet community, the IESG commissions an independent review committee. Having gone through a final review, the specification, then referred to as Proposed Standard, is published as an RFC. It remains at this level for at least six months, thus allowing sufficient time for public consideration and, very likely, revision. After this period, if at least two independent and interoperable implementations exist, the specification is considered as sufficiently stable, and will become a Draft Standard for at least four months [RFC 96a]. Finally, when significant operational experience has been gained, the specification will be raised to the Internet Standard level. If a specification fails to reach the Internet Standard level after two years, it will be reviewed and possibly withdrawn. All decisions relating to advances along the standards track, including final approval and withdrawal, are under IESG responsibility.

Besides this formal standardisation process there is an additional way to foster and publish new ideas, which may ultimately also lead to standardisation. These so called non-standards track RFCs primarily serve as a discussion platform for a wide range of topics, possibly originating from outside the IETF. The formal process associated with those contribution is less strict, with the IESG making an recommendation on whether to publish or to bring the work within the IETF.

4.1.4 Considering User Requirements - The Formal Procedures

The question of how user requirements are integrated into a standard specification has several aspects. One, for instance, is whether or not there actually are any requirements at all prior to a particular standard setting activity, and who has defined them. This is related to the question of whether real-world requirements need to be proved prior to the initiation of any activities, and if they are properly considered subsequently. In the increasingly competitive standardisation environment it would definitely make sense for the standards setting bodies to make sure that the outcome of a prospective new activity meets real user demands, as opposed, for example, to being technically challenging, and that these demands are adhered to during the process. The two aspects that need to be considered in this context are the formal provisions (if any) made by the single standards setting bodies to ensure that both new and ongoing activities are based on real-world requirements, and the way committees translate these provisions into standards (if at all). This section discusses the former, the latter will be addressed in chapter 6.

Both ISO/IEC JTC1 and ITU-T, have established strict formal procedures on how user requirements should be incorporated into the documents. The JTC1/SC18 user requirements procedures [ISO 95i] stipulate that preliminary user requirements have to be included with the document during proposal stage and commented upon by national bodies as part of the balloting process. During the further course of development, the WG in charge shall establish a set of user requirements to be submitted to SC18 for agreement. It should be noted that these requirements are supposed to originate from many sources, including user groups, technical committees and personal contributions. Once a set of requirements has been approved they will be registered as 'Agreed User Requirements' (AURs); subsequent changes must be agreed upon within the WG and reported to SC 18. During preparation of a committee draft an additional document outlining if and how AURs are met by the CD has to be produced and distributed for balloting, along with the proposed CD. No user requirements are considered during the following stages of the process. That is, the formal procedure requires:

- the identification of preliminary user requirements as a mandatory part of a New Work Item Proposal,

- the subsequent agreement of the relevant sub-committee on these requirements, yielding a set of Agreed User Requirements,

- statements identifying how the standards document conforms to these requirements.

Within ITU, responsibilities are assigned to Study Groups (SGs). At present, fourteen SGs are working actively, covering the entire field of telecommunications. Until recently SG1 was in charge of producing 'Service Definitions', which were supposed to reflect user requirements. However, this group was abandoned in late 1996; its responsibilities were transferred primarily to SG 2 [ITU 96]. As SG 2 is also in charge of a number of other, technical questions, this move seems to hint at a lower priority assigned to user requirements. Yet, ITU has always recognised that requirements could as well come from within 'technical' groups, in which case any requirements identified have to be sent to the SG in charge of service definitions for approval through 'Liaison Statements'. This is a highly formalised process. However, no mechanisms have been in place to verify the actual origin of purported user requirements.

Reportedly, cooperation between SG7 ('Data Networks and Open System Communications') and SG1 worked reasonably well in the past; they had co-located meetings, and SG 1 didn't really interfere with the technical work. More recently, the co-located meetings had been abandoned, and contact was limited to the exchange of liaison statements.

In contrast to the other bodies, the IETF does not have any regulations governing the integration of user requirements into their work. The only mechanism that may be used to provide requirements are the 'Applicability Statements' (AS) [RFC 96a]. The broadest type of AS is a conformance specification, called a 'requirements document', for a particular class of Internet systems.

4.1.5 Base Standards vs Profiles

The standards documents published by ISO and ITU (and others) normally describe what can be coined 'Base Standards'. In the area of data communications these have typically been designed within the framework of the OSI Reference Model [ISO 94a]. This model subdivides the tasks to be performed for establishment, management and release of a communication link, and the actual transmission of information, into a stack of seven distinct layers. For each of these layers two or more service definitions and associated protocol specifications are available. Moreover, base standards typically comprise both mandatory and optional functional elements. This variety of functional elements, protocols and services yields an extremely complex hierarchy of possible configurations and resulting functionalities. As a result, there is no guarantee that even implementations fully compliant with a standard (or a stack of standards) can interoperate. Thus, something has to be done to limit the variety of options and to provide guidelines on what should be implemented to actually achieve interoperability. The solution offered by standards setting bodies is the specification of a) which protocols should be implemented and b) which parts of each protocol should be implemented. These specifications are commonly referred to as 'Functional Standards' or 'Profiles'[86]. They establish the platform for implementations.

Figure 4.1.6 shows the basic differences between base standards and profiles. As far as the base standards are concerned, there is more than one protocol per layer, each of which is comparably 'broad', specifying a variety of optional functionalities. In contrast, a profile defines only one protocol per layer and specifies which options to be implemented. Thus, an implementation that sticks to a certain profile will more likely be able to communicate with other implementations of this profile.

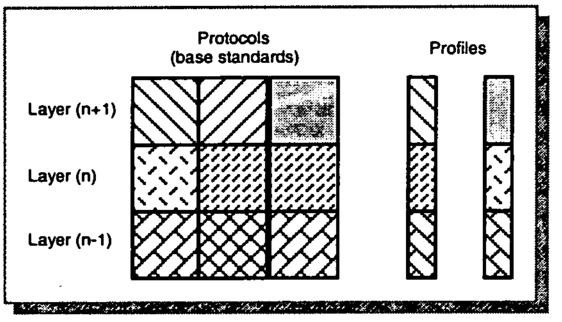

Figure 4.1.6: Base Standards vs. Profiles

It should be noted that profiles are typically produced by regional organisations such as e.g. ETSI[87] or EWOS[88], rather than ISO or ITU. The first such organisation was SPAG[89], founded in 1983. It had been hoped that SPAG members would be the exclusive providers of OSI-based products, and that the functional standardisation would help them increase their market shares [Gensch 95].

Although profiles originate from regional bodies, they are published by ISO as International Standardized Profiles (ISPs). According to [EWOS 96], "*An International Standardized Profile is an internationally agreed, harmonised document which identifies a standard or group of standards, together with options and parameters, necessary to accomplish a function or set of functions*". Some twenty ISPs are currently available for X.400's Common Messaging and Interpersonal Messaging alone.

86 These terms are used interchangeably throughout the literature.

87 The European Telecommunication Standards Institute.

88 The European Workshop for Open Systems.

89 The Standards Promotion and Application Group.

Activities similar to, and in fact based upon, those of SPAG emerged in the US, where two major user companies, General Motors and Boeing, established MAP[90] and TOP[91], respectively, in the late 1980s (see e.g. [Foray 95], [Valen 92]). Figure 4.1.7 shows the general MAP architecture; TOP looks pretty similar.

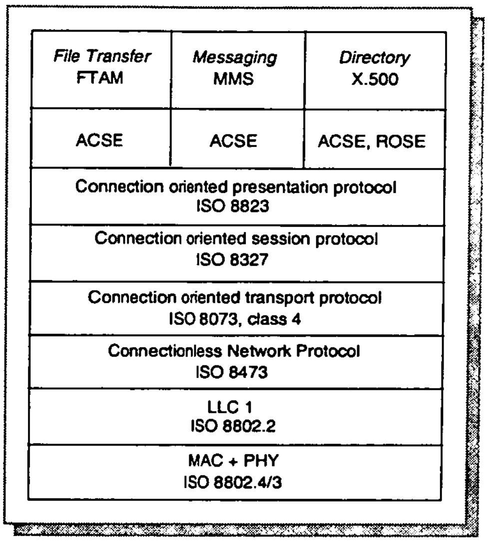

Figure 4.1.7: The MAP Architecture

4.2 The X.400 and X.500 Series of Recommendations - A Brief Introduction

The two following sections provide a brief overview to the two standards discussed in this thesis, i.e. the X.400 electronic mail service and the X.500 directory service.

4.2.1 The Message Handling System (MHS)

This section provides a brief overview of the services offered by MHS. The introduction is followed by a description of those functionalities most crucial to the usability of the service, including interpersonal messaging, addressing, and security.

Introduction

MHS is a vendor-independent electronic messaging system, based on a store-and-forward architecture. It has been standardised by the International Telecommunication Union (ITU) in their X.400 series of recommendations [ITU 92a]. For a more detailed description please refer to these standards documents or to e.g. [Palme 95b].

90 Manufacturing Automation Protocol.

91 Technical and Office Protocol.

Figure 4.2.1 shows the functional MHS model. The user, a human or an application program, accesses the Message Transfer System (MTS) through either a User Agent (UA) or a Message Store (MS). Once a message has entered the MTS, it is routed from Message Transfer Agent (MTA) to MTA until it reaches its destination MTA, which in turn informs the final recipient UA.

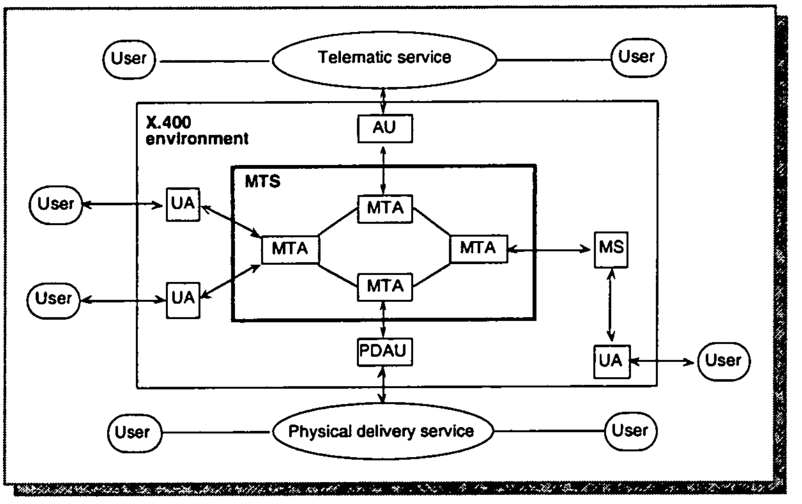

Figure 4.2.1: The Basic MHS Model
MTS = Message Transfer System; MTA = Message Transfer Agent;
UA = User Agent; MS = Message Store;
AU = Access Unit; PDAU = Physical Delivery Access Unit

Users without a UA but with access to other Telematic services (e.g. Facsimile) can also be reached via dedicated Access Units (AUs). Moreover, a Physical Delivery Access Unit (PDAU) provides interconnection to the 'normal' mail delivery service.

A message consists of two basic components: the Envelope and the Content. The envelope carries information required by the system like, for instance, source address and destination address. The content is the piece of information to be delivered to the recipient (cf. Figure 4.2.2).

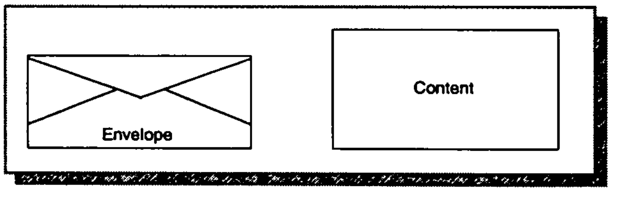

Figure 4.2.2: Structure of an MHS Message

The recipient of a message is identified by an Originator/Recipient Name (O/R Name), which may either be a directory name or one out of a number of different O/R address types, including the mnemonic O/R address, which is virtually the only form being used.

Groups of recipients can be reached through Distribution Lists (DLs). Each DL has an O/R name which identifies its expansion point, ie. the MTA where it is stored. DLs may be nested (cf. Figure 4.2.3).

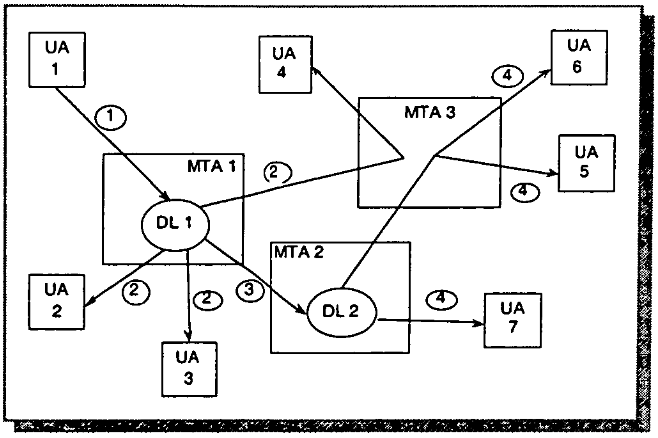

Figure 4.2.3: Use of Distribution Lists

A Message Store can be used to provide a more secure and continuously available storage mechanism, by providing some rudimentary data base functionality. The MS interacts with the MTS on behalf of its associated UA (Figure 4.2.4).

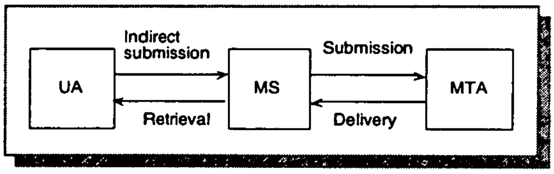

Figure 4.2.4: The Message Store

The MHS recommendations provide for a set of functions extending the basic transfer service, called Interpersonal Messaging Service (IPM service). The IPM service is an extension of the basic transfer service, offering a number of additional 'human-oriented' features closely related to features already known from the office environment. This includes for instance an indication of copy recipients or a subject indication. In particular, interpersonal messages may carry different types of information (multi-part body) including e.g. text, graphics, facsimile and video (see Figure 4.2.5). Body parts defined in the IPM-specification include IA5-Text, Telex, Videotex, G3- and G4-facsimile, encrypted, and voice, with the formats of the latter two being left for further study.

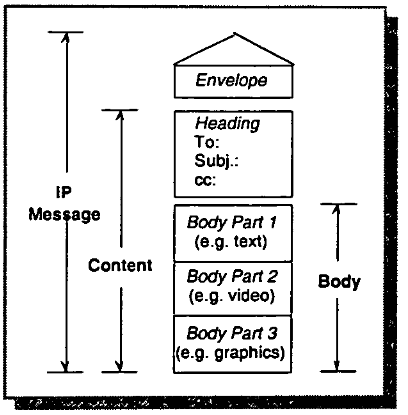

Figure 4.2.5: IP-Message Structure

The MHS organisational model subdivides the global service into different Management Domains (MD), reflecting administrative and/or organisational structures. A domain comprises at least one MTA (see Figure 4.2.6).

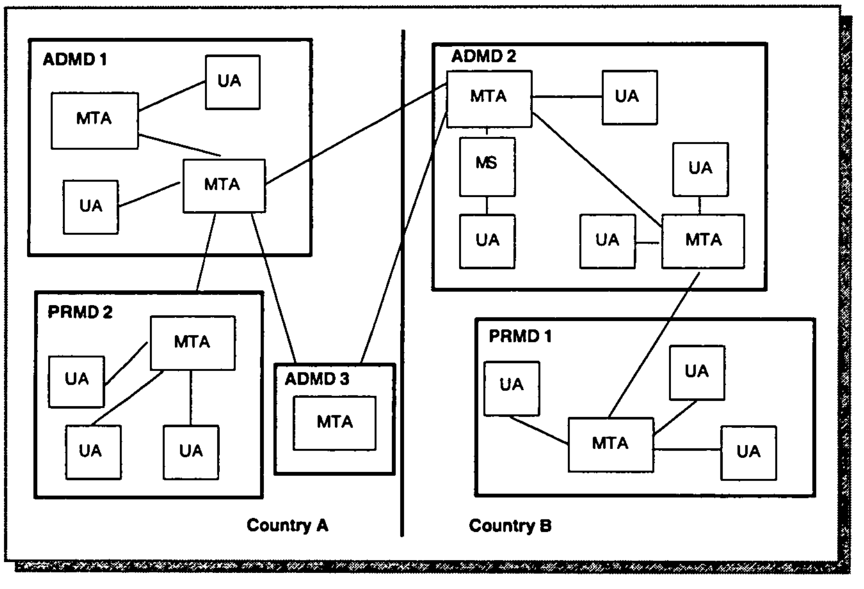

Figure 4.2.6: Relations Between Management Domains

There is a distinction between:

- **Administration Management Domains (ADMD)**
  An ADMD is operated by an administration (e.g. Deutsche Telekom in Germany). There may, however, be more than one ADMD per country.

- **Private Management Domains (PrMD)**
  An organisation other than an administration (e.g. a company) may establish and manage its own PrMD. A PrMD may span country borders.

MHS can make use of services of the Directory Service (DS), including user-friendly naming, support of distribution lists, and authentication services. Figure 4.2.7 shows the functional model of MHS - DS interworking.

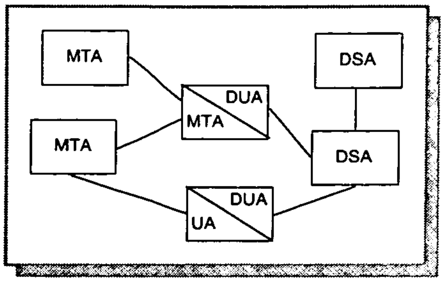

Figure 4.2.7: Interworking Between MHS and the Directory Service
DUA = Directory User Agent; DSA = Directory System Agent

In addition to its message transport related functionalities MHS also provides for security capabilities, including prevention of unauthorised users from misusing the system, and guaranteeing authenticity of received messages. The directory service is used for authentication. Figure 4.2.8 below shows the X.400 security scenario, and the elements of the model between which the single services apply.

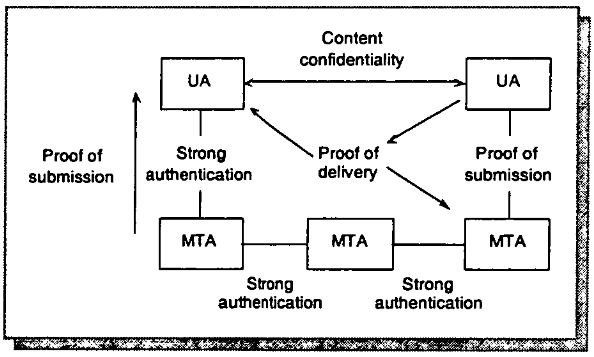

Figure 4.2.8: X.400 Security Scenario

4.2.2 The Directory Service (DS)

This section is intended to provide a very condensed overview of the subject. Those who have a deeper interest in the directory's functionality should read e.g. [Chad 94] or should refer to the original standard [ITU 93d].

Overall Functionality

The directory service provides a uniform naming scheme for, and information about a network's resources (including e.g. hosts, processes, devices and human users). In general, a DS has to provide four types of service:

- **mapping name --> information**
  For example, an object's name may be mapped onto its network address.
- **mapping name --> set of names**
  A set of objects is identified by one single name.
- **mapping information --> set of names**
  This service establishes a 'Yellow Pages' function.
- **secure communication**
  Authentication and mechanisms for electronic signatures are provided.

Usually, the DS is described as a - highly distributed - Client-Server System (see Figure 4.2.9). This may be characterised by a typically small number of hosts (the servers, the Directory System Agents (DSA)) providing callable services to the other hosts of the system (the clients, the Directory User Agents (DUA)).

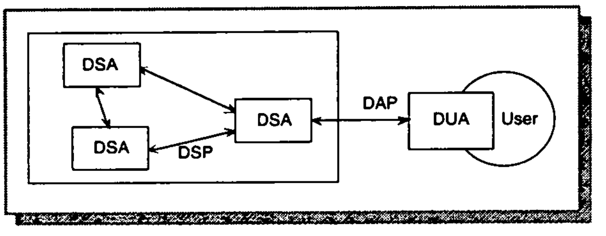

Figure 4.2.9: The General Directory Model
DSA = Directory System Agent; DAP = Directory Access Protocol
DSP = Directory System Protocol; DUA = Directory User Agent

In terms of the DS, resources are referred to as Objects. Every object is represented by an Entry (see Figure 4.2.10), the totality of entries forms the Directory Information Base (DIB). An object's name and the information stored in an entry are composed of Attributes. An attribute is a tuple <AttributeType, AttributeValue>. Attributes may be structured hierarchically.

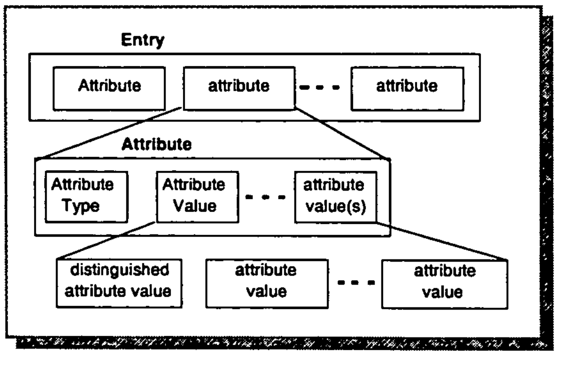

Figure 4.2.10: Model of an Entry (User Information Part)

A Relative Distinguished Name (RDN) is assigned to every entry, and thus to every object. Every RDN is non-ambiguous relative to its immediate superior. The sequence of RDNs of an object plus those of its superiors forms its Distinguished Name (DN, see Figure 4.2.11). The DN is globally unambiguous. The directory also provides for alternative names, called Aliases. An alias entry holds a pointer at the object entry.

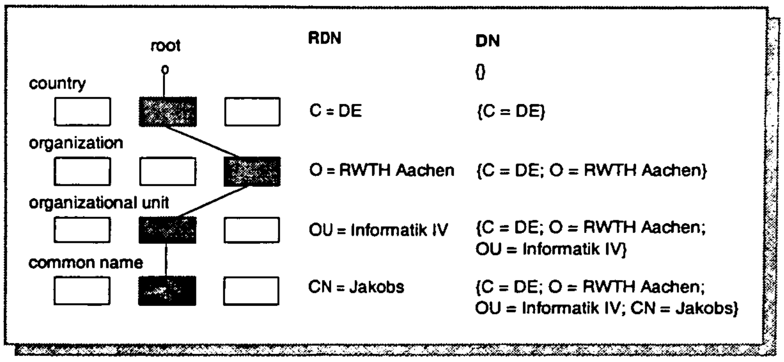

Figure 4.2.11: A Sample Distinguished Name (DN)

Several operations have been defined to search, access and modify the information, including List, Modify, AddEntry, and ModifyRDN. With the exception of the latter these operations only effect leaf entries.

The directory's Schema (see Figure 4.2.12) specifies the structure of the DIB; as this structure will in almost all cases be hierarchical, a Directory Information Tree (DIT) will thus be established.

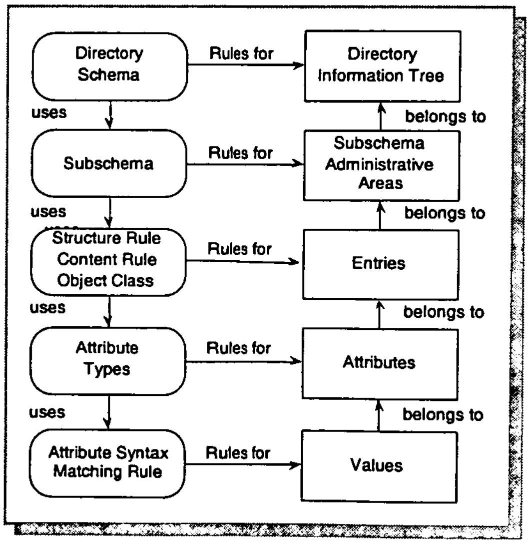

Figure 4.2.12: The Directory Schema

An Object Class definition specifies a set of mandatory and optional attributes for an entry of a given class (e.g. country, organisation), an Attribute Type indicates the type of information (e.g. country name or telephone number) stored in an associated Attribute Value with a defined syntax (e.g. printable string). The schema is composed from a number of Subschemas each valid within one particular management domain.

Every DSA has Knowledge about objects known to other DSAs (to provide for distributed operations). This knowledge is kept in References. To enable distributed operations different modes of DSA interaction have been specified:

- **Chaining**
  The DSA contacted forwards a request to exactly one other DSA, which in turn may forward the request if necessary.

- **Parallel Chaining**
  The DSA forwards a request to several DSAs in parallel.

- **Referral**
  The DSA returns hints at responsible DSA(s).

To increase both performance and availability of the service, data can be replicated. The directory provides for a Shadowing mechanism which enables the replication of part or all of a DSA's information to other DSAs, managed and controlled through Shadowing Agreements, negotiated between participating DSAs.

Different entities will need to have different views of the information stored in the directory. This fact is reflected in the definition of different Information Models, each of which offers specific pieces of data to its respective 'user'. The human user sees what is provided under the User Information Model, i.e. information typically related to other human users. Information related to the operation of the service will be provided for system administrators within the framework of the Operational and Administrative Information Model (e.g. information related to access control rights).

The Administrative Authority Model reflects the subdivision of the DS into (hierarchical) subdomains, each of which is administered and managed by an Administrative Authority. It is this authority's task to assign names and to specify the subdomain's subschemas. Information required internally for DSA operation is subsumed under the DSA Information Model. This includes for example knowledge information and information on shadowing agreements.

Access Control mechanisms allow administrators to implement security policies, i.e. to specify who has access to which information via which operation. The scheme is based on Access Control Lists.

The directory provides for two levels of authentication. Simple authentication is based on a user's distinguished name and a password and is primarily intended for local use, i.e. authentication for example between a DUA and its home DSA. Yet, this simple mechanism may not be sufficient for a number of applications, e.g. for those employed by strategic business-critical processes. Strong authentication provides for secure communication in an insecure environment. It makes use of properties of Public Key Cryptosystems (PKCS). Whereas every PKCS may be used to submit secret information, an additional property is required to make the system useful for authentication purposes as well - permutability. With a PKCS being permutable the secret key may be used to encipher a message. Thus, since the secret key is only known to one particular user, this user's identity may be verified by deciphering the message using the public key. Public keys are created and assigned by a Certification Authority (CA).

Finally, note that the X.500 service directory is based on the overall assumption that information stored will be long-lived. Although this assumption seems to be a little too optimistic [Jak 90b], information may still be regarded as 'long-lived' when compared to data required for example for applications such as traffic control or mobility management. However, recent research (see e.g. [Hoff 96] and [Span 96]) suggests that X.500 is capable of handling even such highly transient data.

Chapter 5

Adoption of E-Mail

This chapter will look at the problems and issues surrounding the introduction, and subsequent use, of messaging systems in large, internationally operating organisations. In sect. 5.1, I will discuss functional requirements on e-mail and directory services, which have been identified through in-depth literature studies and interviews[92]. This section will show that the vast majority of requirements identified thus far are still surprisingly sperficial and sketchy. Subsequently, I will describe and discuss the different adoption strategies that have been identified through the case studies (in sect. 5.2). Eventually, lessons learned from this chapter will contribute to the motivation for a new model of the standardisation process.

5.1 Functional Requirements on E-Mail and Directory Services

Functionality is one of the crucial contributors to a service's usability and particularly to its usage (see e.g. [RACE 94], [Jak 95a] [Dick 92], Figure 5.1.1). Accordingly, in order to provide a usable service it is important to assure that its functionality actually meets users' requirements. This, in turn, makes it necessary that these requirements are known beforehand, i.e. prior to the actual implementation of the service, prior to the decision how to implement it and, in fact, prior to the decision whether or not to

92 A listing of the single requirements identified, including some comments, will be given further below.

implement it at all. The question to be asked at this stage is "Will this particular implementation of this particular service suit my current and likely future needs?".

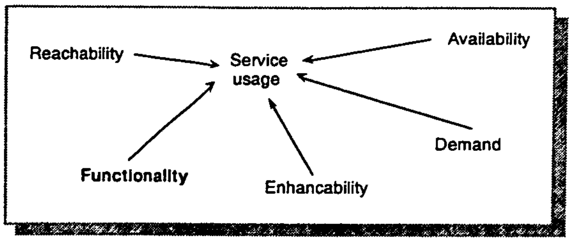

Figure 5.1.1: Functionality as a Contributor to Service Usage
(adapted from [RACE 94]).

Before continuing, it will be helpful to recap the distinct definitions of two terms (as they are used in this context) which should not be confused:

- *Service* refers to the functionality as specified in some (standard) document. For instance, the X.400 series of recommendations [ITU 92a] define the ISO/ITU e-mail service (and related aspects), the Internet e-mail service is specified by a large number of RFCs (e.g. [RFC 82a], [RFC 82b], [RFC 96a])

- An *Implementation*[93] of a service is one particular expression of (a subset of) this service, offered by a service provider or by vendor.

Identifying requirements is only a first - though important - step. Subsequently, different services (e.g. X.400 vs Internet mail) and competing implementations of these services need to be evaluated in the light of the requirements identified.

Many standardisation officials, as well as a number of scholars, claim the need for far more users on the committees to guarantee that the final standards can survive in the marketplace (see e.g. [Bogod 90], [ETSI 92], [Fisch 90], [Hawk 95a]). This holds especially for those committees working in the area of IT standardisation. Moreover, existing systems are in many cases said to not live up to their users' needs (see e.g. [EEMA 94a], [Ferné 95]). The natural conclusion then is that there will be a gap between functionality provided by today's standardised IT-systems and the actual user requirements.

93 Please note that the meaning of the term in this chapter 'implementation' differs from the meaning associated with it in previous chapters deriving from innovation studies. Here, it is used as in computer-science.

From this it follows that an evaluation of these services is likely to expose a number of shortcomings of the service definitions. Whilst such an evaluation cannot solely be based on the respective functionality, it nevertheless remains an important criterion[94]. This section thus serves as a case study on the quality of the outcome of the 'traditional' voluntary standards setting process, taking electronic mail and directory services as examples. It thus contributes another piece to the jigsaw that will eventually turn into a coherent view of this process.

In the remainder of this section I will first match actual requirements on e-mail and directory system against services specified in the X.400 and X.500 series of recommendations. Please note that I will not consider Internet services and proprietary systems. Moreover, I will look only at the underlying standards documents rather than actual implementations. This is due to several reasons:

- X.400 and X.500 recommendations define more feature-rich systems than their RFC counterparts (note, however, that this does not necessarily hold for all implementations).

- At least among the companies studied X.400 is far and away the prevailing service of choice in the area of integrating e-mail backbones. In fact, there has been a clear trend away from proprietary systems towards open, X.400 based solutions. If a uniform directory service has been implemented at all, X.500 has been the number one. However, it should be noted that the base of installed X.500 systems is much smaller than its X.400 counterpart.

- The service specification documents provide some sort of superset of the functionalities offered by their single implementations. If they fail to meet user demands, some major activities will be required to change this situation (i.e. modify the standard). In contrast, if a particular implementation does not live up to its users' needs, something can be done about it far more easily (at least in theory).

The requirements on electronic mail and directory services compiled and briefly described in this section originate from a variety of sources. However, it has to be

94 Other important issues to be considered include for instance the system's integration into the existing IT-environment, its fit into the organisational structure, and its support of existing work processes.

stressed that this compilation only provides a snapshot of requirements. New, additional requirements are likely to surface continuously, others may disappear, for instance as a result of organisational changes. Thus, the compilation and the subsequent analysis should only be seen as a case study exemplifying to what extent - if at all - the two sample standards manage - or fail - to live up to their users' needs and requirements.

5.1.1 Compiling Requirements

The full list of requirements, together with some brief comments and explanations, will be given below. This list has been compiled from a broad range of publications and from my survey data. The former includes US government reports, RACE[95] CFSs[96], project reports, Internet RFCs[97], EEMA[98] documents, and various research papers. They represent the demands of very heterogeneous user communities from different domains, including

- Government agencies [EMPP 94], [NPR 94], [Euro 96],
- R&D institutions [CAR 90], [Hei 92], [Jak 90a], [Jak 92], [Jak 93], [Pan 90], [Pow 92], [RACE 94], [RFC 91], [RFC 94b], [RFC 94c], [Toro 92],
- Corporate users [EEMA 94a], [EEMA 94b], [EEMA 94c], [EEMA 96], [Ovum 94].

In addition, non sector specific requirements have been included from [Bäl 95], [Jak 95a], [Jak 96a]. Only the more prominent requirements, i.e. those identified in more than two sources, are considered. It should be noted that the majority of these cover fairly general issues. This is understandable since the requirements have largely been compiled a priori, i.e. before the actual uptake of an e-mail service in the respective organisation. There is, however, one notable exception: the European Electronic Messaging Association has prepared a White Paper [EEMA 96] to serve as a guideline specifically for service providers and vendors on what needs to be implemented to

95 Research and Development in Advanced Communications Technologies in Europe, a European R&D programme.

96 Common Functional Specifications, a compilation of results from RACE projects, detailing principles, guidelines and specifications related to Integrated Broadband Communications (which includes e-mail and directory services).

97 Request for Comments, an Internet publication series, inter alia including the Internet standards.

98 The European Electronic Messaging Association.

achieve user-friendly, cost-effective and secure global e-mail communication. The paper has been compiled from various sources, notably including the EEMA User Committee[99] as well as other interested EEMA committees. The requirements identified focus on functional, organisational and administrative issues. The document does not specify how functionality necessary to meet the requirements should be implemented. Thus, its scope is pretty much in line with the overall scope of this section, in that it focusses on functionality rather than a specific implementation, and represents the agreed requirements of a considerable number of user representatives rather than the ideas of a single user or service provider.

Regarding the requirements obtained through the survey again only those identified by several users are subsequently considered. It should also be noted that these requirements result from considerable experience with corporate e-mail systems; each of the companies studied has been using e-mail for at least ten years. A significant number of additional requirements identified should therefore be expected.

5.1.2 Identification of Gaps

The compiled requirements cover a broad range of issues, including some beyond pure service functionality. Availability and reliability, for instance, can hardly be regulated by a technical standards document. The same holds when it comes to e-mail interworking; despite the fact that specifications are available defining e.g. the way message bodies or addresses should be mapped from e.g. Internet mail to X.400 or vice versa (as e.g. [RFC 89], [RFC 93], [RFC 95a]), it is still up to the respective service provider(s) whether they implement these specifications, and whether they implement them properly.

Thus, a distinction has to be made between what is in a standard, and what is actually being implemented and offered to customers. It is fairly common, at least in the X.400 world, that service providers only implement certain subsets of the respective recommendations. Again, whilst this may be a nuisance for the user, it is beyond standardisation.

Subsequently, I will discuss the identified requirements, and indicate whether or not they can be considered as being met by the functionality provided by the X.400 and X.500 series of recommendations, respectively.

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99 Of which I am a member.

- **The system must reliably send and receive messages.**
  This is the most basic requirement for any e-mail system. It is fulfilled by the mere existence of X.400-based e-mail networks.
  Both, ITU and ISO stay clear of implementation issues. Thus, as far as reliability levels are concerned, this is outside the scope of a technical standard. Rather, such issues will have to be settled through service level agreements between users and service providers and/or vendors.

- **Users should be able to receive messages from any other user at any time**
  Generally, messages can be delivered from the destination MTA (which should always be on-line) at any time. Whether the message can be delivered to the final UA depends on whether or not the UA is active. Alternatively, in case a Message Store (MS) has been installed, in principle the message can always be delivered.

- **It should be possible to interconnect different messaging services.**
  The recommendations of the X.400 series do not cater for interconnection to other, non-MHS services. Interconnection may only occur between management domains. Thus, dedicated, non-MHS interworking entities (gateways) are required if X.400 systems are to be interconnected to proprietary or SMTP-based systems. No specifications for such gateways are provided within the X.400 framework (nor within the OSI environment). Currently, only Internet RFCs are available as a basis for the interconnection of SMTP- and X.400-based systems [RFC 93], [RFC 95a]. Proprietary products based on these RFCs are required for the integration of X.400 and other e-mail systems. Thus, while gateways providing for the requested functionality can be bought off-the-shelf, this is outside the scope of X.400 specifications (which implicitly assume a pure X.400 world, plus some telematic services). It would, however, be helpful if the RFCs, or documents based on them, were adopted by ITU and ISO.

- **Interoperation between e-mail and other services is required.**
  X. 400 specifies dedicated Access Units providing interworking capabilities between the Interpersonal Messaging System (IPM) and other messaging services, including Telex [ITU 88a], Teletex [ITU 88b], and Facsimile [ITU 92f]. In addition to that, interworking with the Physical Delivery Service (i.e. surface/air mail) is provided [ITU 88c]. Only limited subsets of the IPM's

elements of service are available through the respective Access Units. In this general form, the requirement is met by the IPM service's functionality.

- **It is absolutely crucial that no information is altered in transit.**
  There are several aspects to this requirement. Firstly, the system itself must not alter the content of messages. According to [ITU 92a1], *"The MTS neither modifies or examines the content, except for conversion."* Again, this is fundamental. Secondly, the UA can explicitly prohibit conversion in case of loss of information or prohibit conversion altogether. On the other hand, conversion between different encoding types may be desirable (and can explicitly be requested) to tailor a message to the capabilities of the recipient's end system. Finally, unauthorised conversion by third parties must be prevented. MHS provides security features related to that requirement, notably 'content integrity', which enables the recipient to verify that the message has not been altered in transit (see below). This requirement is met by X.400's functionality.

- **Messages and delivery notifications will have to be delivered to the recipients within a predefined time (typically 30 minutes).**
  There are two ways how time targets can be specified by the originator of a message. A 'grade of delivery' can be assigned to a message [ITU 92d] specifies different time targets:

Grade of delivery	95% delivered within	Maximum delivery time
Urgent	0.25 hours	2 hours
Normal	1.0 hours	6 hours
Non-urgent	4.0 hours	12 hours

Table 5.2.1: Delivery Time Targets

The grade of delivery specifies the maximum time after which the message will be canceled and a non-delivery notification be issued. In addition, the 'latest delivery designation' element of service enables an originating UA to specify a shorter time within which the message must be delivered.

These time targets are valid for ADMDs only. If the originating UA and/or the recipient UA are located within PRMDs interconnected through one or more ADMDs, internal PRMD delivery times have to be added to the above time targets. Additional time targets have been specified for transit-ADMDs:

Grade of delivery	95% delivered within
Urgent	10 minutes
Normal	35 minutes
Non-urgent	2.4 hours

Table 5.2.2: Transit Time Targets

No user-specified time targets for delivery notifications are available; [ITU 92d] requires for both, delivery and non-delivery notifications, that 95% be delivered within fifteen minutes.

According to [ITU 92a2], there is no upper limit in the number of ADMDs required to interconnect any two PRMDs. It follows that no guarantee can be given that a message actually reaches its final destination within the specified time frames. This, in turn, means that a non-delivery notification may be issued although transit time targets have been met, simply because the number of ADMDs to be passed was too big. This holds particularly for 'urgent' messages in which case three transit ADMDs may suffice to cause this effect.

At least in theory, therefore, the accumulation of these two effects may potentially cause a significant number of falsely issued non-delivery notifications. Thus, if the desired target of thirty minutes is to be considered a 'hard' requirement, it is not met by the current specifications for public message transfer services. However, this very much depends on infrastructure, implementation and actual load characteristics, and is therefore to some extent outside the scope of a technical standard.

- **The 'least cost route' should always be chosen.**

  According to [ISO 96a], the originator does not specify a path through the MTS. Rather, the information needed to perform routing is set up by the respective administrator. As a consequence, the user has no direct control (save bilateral agreements) about the route taken by a message once it leaves the local domain. On the other hand, routing may be based on 'least-costs' within a domain. Whether or not this requirement is met depends largely on the definition of the term 'cost': in case of monetary costs, a user will only care about the price of a route within the local domain since tariffing is normally based on data volume, rather than the actual route taken. If 'cost' means 'high security threat', this requirement is fulfilled since X.400 allows avoiding insecure domain or MTAs (see below). Finally, if 'cost' means 'delay', this requirement is not met.

- **Mechanisms to detect and protect against viruses should be provided.**

  The MTS neither interprets nor alters the content of messages (except for conversion if requested; cf. [ITU 92a1]). Thus, the MTS cannot perform any virus checking.

  According to [ITU 92a4], an 'auto-action' may occur automatically whenever a set of predefined associated criteria have been met. These criteria may be conveyed to the MS by means of registration or subscription. This mechanism could be used to invoke a virus checker upon receipt of certain messages (especially those that include executables). Whilst [ITU 92a4] also provides for mechanisms to have certain actions registered and object identifiers assigned to them, it is an implementation issue which actions are available to end users. Virus checking could also be performed on a purely local basis, i.e. using local mechanisms integrated into the user agent. Thus, it is possible to meet the requirement by utilising X.400 functionality.

- **Multiple security levels are required.**

  X.400 specifies a number of security related service elements, combinations of which should adequately support a sufficiently broad variety of security policies. However, it should be noted that the security features only serve to safeguard communication between the components of the MHS, i.e. MTAs, UAs, and MSs. In particular, they do not cover remote access to a User Agent. The following service elements have been defined [ITU 92a1], [ITU 92a2]:

  - Message origin authentication: enables the recipient, or any MTA through which the message passes, to authenticate the identity of the originator of a message.
  - Proof of delivery: enables the originator of a message to authenticate the delivered message and its content, and the identity of the recipient(s).
  - Proof of submission: enables the originator of a message to authenticate that the message was submitted to the MTS for delivery to the originally specified recipient(s).
  - Secure access management: provides for authentication between adjacent components, and the setting up of the security context.
  - Content integrity: enables the recipient to verify that the original content of a message has not been modified.
  - Content confidentiality: prevents the unauthorised disclosure of the content of a message to a third party.

- Non-repudiation of origin: provides the recipient(s) of a message with proof of origin of the message and its content which will protect against any attempt by the originator to falsely deny sending the message or its content.
- Non-repudiation of submission: provides the originator of a message with proof of submission of the message, which will protect against any attempt by the MTS to falsely deny that the message was submitted for delivery to the originally specified recipient(s).

Moreover, security labelling provides for a means to categorise a message with respect to its sensitivity. A message will be processed according to the security policy associated with this label. With such labels also assigned to MHS entities (i.e. UAs, MTAs, MSs) this may, for instance, be used to avoid MTAs or domains perceived as not being sufficiently secure.

Many of the service elements listed above (e.g. origin authentication and content confidentiality) rely on authentication and encryption services to be provided by the Directory [ITU 93f3]. Thus, if X.500 were available, the requirements would be met by the combined X.400/X.500 functionality.

- **In case of a non-delivery notification supplementary information should be provided.**

  A wide range of such supplementary information is conveyed by the 'no-delivery-reason-code' (eight possible values) and the 'non-delivery-diagnostic-code' (forty-nine possible values) arguments of the 'MTS report-delivery operation' [ITU 92a6]. Unless the nature of the supplementary information required is not precisely specified, this requirement is met.

- **Consistent time stamps should be provided.**

  Whilst several time-stamps are provided by the service (e.g. delivery/ submission time stamps), the recommendations do not specify a format for these time stamps. This is an implementation issue.

- **Different national character sets should be supported.**

  A distinction has to be made between

  - Characters allowed in body parts

    The standard provides for the use of virtually arbitrary character sets, for instance via the 'extended' body part. Abstract syntax and semantics of the information object represented by this body part are identified through a non-ambiguous object identifier.

The 'general text' body part also enables use of character sets which have previously been registered. It is possible to use different character sets within one body part.

- Characters allowed for O/R addresses

  Printable strings are to be used for most address attribute types, including 'common-name', 'personal-name', 'organization-name' and 'organizational-unit-name'. For the remaining types, numeric strings [ITU 92e] can be used.

Functionality specified in the X.400 series is sufficient to meet this requirement.

- **Multiple different binary attachments should be supported.**

  The term 'attachment' is unknown in the X.400 world. Rather, the Interpersonal Messaging Service provides for a number of pre-defined different body parts types (to convey e.g. videotex or G3 facsimile), including the 'Extended' body part type (see above). These body parts can be used to transmit separately encoded information.

  A 'File Transfer' body part has been defined, based on the file model as specified in the FTAM[100] standard [ISO 88b], which can be used to transmit arbitrary binary files and thus provides for the same functionality as does an attachment.

  In general, any data formats may be registered with an administrative authority which assigns a unique Object Identifier to each newly registered body part. Each body part may then be referenced through its object identifier. Thus, an organisation may for example define dedicated body parts for every word processor and every spreadsheet it uses (or use those that have already been defined elsewhere). The requirement to transfer multiple, separately encoded binary files via one message is fulfilled.

- **An External Body Part should be supported.**

  As an 'external body part' is supposed to serve similar purposes as attachments, the same arguments as above apply here as well.

- **User addresses must be unique.**

  X.400 addresses are structured hierarchically, starting at the global level. A level (n+1) management entity is in charge of all address parts issued for level (n). Thus, uniqueness for each level can be ensured, including the personal name

100 File Transfer, Access and Management.

parts of the address (i.e. the 'S', 'G', and 'I' parts) which can for instance be issued by entities of the 'OU' or 'O' level. This requirement is met.

- **There should be no restriction on the maximum message size.**
  The recommendations do not specify any maximum message sizes. However, implementation specific limitations may occur in both, MTAs and UAs. Probe messages can be used to find out about the latter; the former solely depends on the implementation. As far as the standards are concerned, this requirement is met.

- **Messages must still be delivered as soon as possible after the target period has expired.**
  A non-delivery notification is issued when either the maximum delivery time or the latest delivery designation expires (whichever comes first). From the discussion (on time targets) above it can be concluded that this requirement is not met by the current specifications.

- **There must be facilities to divert messages**
  Two related mechanisms are provided. The service element 'redirection of incoming messages' enables the UA (and thus the user) to redirect incoming messages for a given period of time or until revoked. Redirection may be subject to security mechanisms.
  The Message Store (MS) provides for auto-forwarding of messages. This action is performed by the MS service provider. A message to be auto-forwarded must first be stored in the intended recipient's MS. A number of criteria may be specified that have to be fulfilled in order to auto-forward the message. This requirement is met by X.400's functionality.

- **It should be possible to switch off (non)-delivery notifications.**
  If a message cannot be delivered properly a non-delivery notification is automatically generated by the Message Transfer System (MTS) [ITU 92a2]. This can be switched off on a per-recipient basis by the originating UA through the 'prevention of non-delivery notification' functional element.
  Automatic non-delivery notifications are not always generated for users interconnected to the MTS via dedicated Access Units. X.400's functionality is sufficient to meet this requirement.

- **Users must have feedback about the message status.**

  Feedback on a message's status refers to e.g. delivery, receipt, or re-direction. It may also refer to information required in case of a system failure. For the former several elements of service are provided, particularly including [ITU 92a2]:
  - Delivery notification: the originating UA may request that it be notified when a submitted message has been successfully delivered to a recipient UA. It should be noted that this does not imply that the message has actually been read.
  - Non-delivery notification: the MTS notifies the originating UA that a submitted message was not delivered to the specified recipient UA(s). This notification includes the reason for the non-delivery. A non-delivery notification is generated automatically.
  - Receipt notification request indication: this element of service can be used by the sender to ask for a notification if and when the IP-message has been received by the recipient's UA. However, it is up to the respective recipient whether or not this request is honoured. If it is honoured, a receipt notification will be sent.
  - Non-receipt notification request indication: this allows the originator to ask for a notification if a message was not received by the recipient UA. This may, for instance, happen if a message was auto-forwarded by the recipient UA. A non-receipt notification will be sent automatically by the receiving UA for instance if the message was auto-forwarded or discarded prior to receipt.
  - Proof of submission: this serves to authenticate that the message was submitted for delivery.
  - Non-repudiation of submission: this provides the originator of a message with the conclusive proof that a message was submitted to the MTS for delivery; analogous to the above element of service.

  These elements of service, and especially combinations thereof, provide for a broad range of status-related reports on transmitted messages that may be requested by the sender.

  Functionality specified regarding other status information is extremely sketchy. As a unique message ID is provided, this can be used to provide for further status information. However, nothing specific is laid down in the relevant standard documents; provision of related functionality is up to the respective service provider. In case of a system failure messages not yet delivered are required to be traceable, and non-delivery notifications must be issued appropriately. Yet, the requirement may be considered as by and large being met by X.400.

- **Users should be able to send the same message to more than one user simultaneously.**
  In principal there are three possible ways how this functionality can be realised: either locally, through user-maintained local lists of recipients, or through (centrally managed and maintained) Distribution Lists (DLs). Whilst imposing no limits on a user's private lists, X.400 provides for such DLs [ITU 92a1]. The third alternative would be to use an entry of the pre-defined X.500 object class GroupOfNames (or a similar one) [ITU 93f8]. Entries of this class contain distinguished names of group members.
  A DL is managed by a dedicated owner, who is responsible for keeping a list of DL-members and for issuing submit-permissions. A DL can be addressed via normal O/R-names; a user need not even be aware of the fact that he is addressing a DL. DLs may be nested, and special rules for notifications and recursion control apply. This requirement is fulfilled by the services provided by X.400.

- **The same contribution can be sent to more than one group with a single command.**
  DLs may be nested, thus providing for delivery of messages to several groups. Second, the service element 'multi-destination-delivery' may be used to deliver messages to multiple groups in the same way as they may be delivered to multiple users. X.400 provides sufficient functionality to meet this requirement.

- **Whiteboard services should be provided.**
  The functionality of a 'whiteboard' is close to that of a Usenet Newsgroup. That is, subscribers can participate in an asynchronous online discussion, which may be moderated (contributions are checked for e.g. suitability by a group moderator prior to actual submission to the group) or restricted in membership (limited to company employees, for instance).
  Although both ISO and ITU have been active in this field for a number of years ([ISO 94b], [ISO 94c]; ITU discontinued work after 1992) progress so far has been slow; the current version of the documents have not yet reached DIS status. Thus, at present, no such services are provided. The requirement for a whiteboard service is not met by the current specifications, however, it may well be considered as being outside the scope of a messaging service to provide for whiteboards.

- **A 'Call Barring' function should be available.**
  Different possibilities exist how to bar certain messages. One such mechanism is provided through the 'user/UA capabilities registration' element of service, which can be used to reject messages with given characteristics such as
  - the content type(s) of messages it is willing to have delivered to it,
  - the maximum content length of a message,
  - the encoded information type(s) of messages.

  The 'restricted delivery' element of service allows a receiving UA to identify UAs and DLs messages from which will not be accepted. In both cases the MTA will not deliver messages with any of the excluded characteristics. This requirement is met by the functionality provided by X.400.

- **In case of a non-delivery notification it should be possible to have the message content returned as well.**
  The 'MTS message-submission' operation enables an MTS user to submit a message to the MTS. One of the arguments of this operation is the 'content return request'. This requirement is met.

- **The user should be provided with mechanisms to conveniently manipulate messages.**
  The MS's capabilities focus on data base-like functionalities, as e.g. fetching, listing and deleting messages, plus alerting (upon receipt of a message with pre-defined criteria) and auto-forwarding. Apart from that, no restrictions or regulations apply as far as local functionality is concerned. In particular, the capabilities of a User Agent (as for instance integration of word processors for message editing) are a local matter and therefore outside the scope of standards.

- **It should be possible to specify mandatory routes.**
  Routing decisions are taken at MTS level, with the routing procedure being based on information stored in a directory entry (or possibly based on local routing tables) [ITU 92a2], [ISO 96a]. However, transitting certain domains which are considered insecure can be avoided through appropriate use of message-security labels. Security levels can be specified which are not met by these domains' security contexts. Thus, while no mandatory routes can be established (with the exception of dedicated multilateral agreements), it is possible to guarantee that a messages traverses only sufficiently secure domains. Despite this possibility this requirement is not really met by X.400.

- **There has to be an adequate global directory service.**
  This is a most basic requirement which does not have very much to do with a standard specification, especially since what exactly 'adequate' means has not been elaborated. However, it may be anticipated that more specific requirements surface once a global directory service has been established, and some experiences and a better understanding of the associated problems and issues been gained.

- **The directory should cover the full user population.**
  Again, this is a very straightforward requirement; usefulness of the directory increases with the number of entries. This is a problem that can only be solved by the open market. If the usefulness of the directory service were widely understood, extensively implemented and offered at a reasonable price the number of users would grow automatically. As these preconditions are not yet met (at least not as far as X.500 is concerned) it remains to be seen whether the requirement will ever be met. However, it is outside the scope of a standard to deal with issues like that.

- **Information stored in the directory must be up-to-date and accurate.**
  Another obvious need; what has been said above applies here has well. The original assumption was that information to be stored in the DIB would be very long-lived, and that modifications would be required very infrequently. This included particularly the Distinguished Name. However, experience indicates that this assumption was not very realistic [Chad 96a].
  The Directory provides for four operations to modify the Directory: `addEntry`, `removeEntry`, `modifyEntry`, and `modifyDN`; the two former refer to leaf entries only. Thus, the functionality required to enable users to update their entries is available. However, it is questionable whether or not it is desirable to allow users to modify their entries themselves, or to have a local administrator or a central management entity cope with that [Chad 96a]. In any case, from the technical point of view this requirement is met (but see below for preservation of information consistency).

- **Information stored in the directory has to be consistent.**
  As any global directory service will necessarily be distributed, and data will be replicated, information inconsistencies may occur. X.500 allows temporary

inconsistencies during the replication process [ITU 93f9]. Inconsistencies may also occur in case of 'caching' of information. This refers to data being stored locally by a user. As this is not controlled by the system, cached data may well become invalid without notice.

In general, there are two ways to avoid inconsistencies:

- To use an underlying protocol that guarantees consistency, for instance a two-phase commit protocol, as e.g. OSI CCR (Commitment, Concurrency and Recovery, [ISO 90]). This ensures that inconsistencies cannot occur by blocking data until update has been successfully finished. However, with a globally distributed service and a considerable daily number of update operations, this is by no means a realistic option.
- To do no replication at all. Whilst this is possible, it would severely decrease availability of data and performance of the overall system. Again, this is no realistic solution.

Both options are not very realistic. However, there seems to be no way to overcome this problem by means of a communication service. Thus, users of X.500 will have to live with some degree of temporary inconsistency.

- **The directory should be able to store a broad variety of information.**

  The directory has been designed to cope with a broad variety of information. Accordingly, a considerable number of different Attribute Types [ITU 93f7] and Object Classes [ITU 93f8] have been specified. In addition, subschema administrative authorities are free to define parts of their subschema, according to their needs and requirements [ITU 93f5]. This leaves an administrative authority with the greatest possible freedom for defining its own subschema. Elements of a subschema may be registered, in which case they are published and assigned an object identifier. The requirement is met by X.500's functionality.

- **The directory should be reasonably fast.**

  This is yet another very general requirement, which to a large extent depends on implementation characteristics. Other influential factors in this context include DSA capacity and speed, bandwidth available for DSA access, search algorithms used (especially in case of a Yellow Pages service), degree of replication, and so on. These are matters outside the scope of a standard.

- **Organisational contact details should be accessible through the directory.**
  This can be stored in a directory entry. Whether an organisation actually provides this information is outside the scope of a standard. From the technical point of view, this requirement is met.

- **There should be alternative access methods to a directory service.**
  Whilst such functionality has already been implemented - e.g. X.500 access through the World Wide Web - I would consider this as being outside the scope of the standard.

- **Automatic address registration should be supported.**
  Auto-registration can easily be supported by X.500, yet additional functionality is required to actually achieve it. If, for example, a new user is to be registered with an organisation, this will require some action from the local administrator anyway. If, on the other hand, originators of incoming messages are to be added to the local DIB, some routines can easily extract relevant information from this message's header and create an appropriate new entry. Thus, meeting this requirement is yet again outside the scope of X.500.

- **The directory must be easy to use.**
  In the absence of more specific requirements it may be anticipated that the functionality specified in the X.500 series is sufficient to meet users' needs. Whether or not the functionality is actually implemented (i.e. available to the user), and whether it is provided in a sufficiently user-friendly way by the local implementation of a directory user agent is beyond the scope of a standard.
  The above requirements have been compiled from literature, the remaining list has been extracted from interviews. Only those requirements are listed that have not already been addressed above.

- **Seamless global X.400 messaging should be possible.**
  Neither ADMD - ADMD and PRMD - ADMD, nor PRMD - PRMD interconnection should be a problem. However, a 1995 ADMD interconnection matrix [EEMA 95] shows that full interconnectivity is far from being achieved, but also that the situation is improving.
  This is very much an organisational problem; from the standard's point of view interconnection of management domains is not an issue. Thus, bilateral

agreements between service providers, as well as alignments of the different implementations are required to actually achieve transparent domain interconnection.

Today, however, organisational problems still seem to prevail; yet, such problems are outside the scope of the standards.

- **There is an urgent need for user-friendly addressing and naming.**

  This was an unanimous requirement, topping virtually every wish list.

  MHS users are addressed via O/R names (cf. sect. 4.2.1). An O/R name comprises an O/R address, and/or a distinguished name (DN). Both, O/R addresses and distinguished names are composed from attributes, i.e., they each form an attribute list. An attribute is a tuple <type, value>, e.g. Country = UK.

  Both, O/R addresses and DNs are supposed to be user-friendly. Unfortunately, this term has never been defined. From the comments made by the interviewees it may be concluded that user-friendly is synonymous to "easy-to-guess, easy-to-remember, reasonably short, and not to be used for routing decisions".

  For clarity it will be helpful to discuss O/R addresses and DNs separately. Unless a global directory service becomes available, an O/R address is the only means to identify the recipient of a message (or a probe). Of the various O/R address forms supported by the standard, only the 'mnemonic' form, which is said to provide *"... a memorable identification of a user ..."* [ITU 92a2] will be considered here. This form comprises of the two mandatory parts 'Country = ' and 'ADMD = ' (national policy permitting, the latter may have the value ' '), plus a selection of conditional parts. As no global rules exist on how the address is to be composed, name forms may vary between domains. Addresses are therefore hard to guess without prior knowledge about the addressing policy in force in the recipient's domain. Analogously, the length of the address may vary considerably; today it typically - but not necessarily - includes 'organization-name', one or more 'organizational-unit-names' and 'personal-name'. The mandatory parts, especially the 'ADMD' part, are relics from the past when national telecommunication monopolies were still beyond questioning and multinational service providers a thing basically unheard of. These parts are primarily included for routing purposes.

  The address type that may be considered as user-friendly is the 'unformatted postal address'. This type is stored in a single attribute, the structure of which is not prescribed. Unfortunately, this address is only valid in conjunction with the 'postal delivery service'.

Some of the problems mentioned above hold for DNs as well, including the lack of an overall naming schema, specifying a uniform name form, which again significantly reduces the guessability of a name. On the positive side, by definition no routing-related information is included in a DN. Still, even if a global directory service were available, the user-friendliness of O/R names would not increase significantly.
It is most unlikely that the X.400 specifications of O/R names will be changed to achieve really user-friendly naming and addressing. New versions of the directory may include mechanisms to enhance user-friendliness (as e.g. descriptive names, see [ISO 86] and [EB 92]), however, this as well is most unlikely. For a suggestion on how to achieve user-friendly names using X.500 see [RFC 95b].
It must be concluded that, depending on the definition of the term 'user-friendly', this requirement is not - and probably will not be - met by the standard specifications. The only way to reduce this problem seems to be multilateral agreements between providers, or agreed global uniform name forms, plus possibly sophisticated user agents. Depending on the definition of 'user-friendly', this requirement is not met, neither by X.400 nor by X.500.

- **The contents of error messages should be in plain language.**
  No error messages have been specified in the standards, and must indeed be considered as pretty much implementation specific and thus as being outside the scope of standardisation (for instance, they could be in the respective national language).

- **Comfortable facilities for editing, retrieving and re-using of messages are needed.**
  The Message Store provides, among others, the functionality required to store and retrieve messages in a convenient way. Related operations include 'summarize', 'list', 'fetch', and 'delete'. Selectors and filters to specify, and subsequently manipulate, single messages or groups of messages are also provided. This functionality supports re-use of messages as well. This part of the requirement is met.
  Integration of a word processor or other editing functionality is a purely local matter, beyond the scope of standardisation.

- **Auto-replies should be supported.**
  'Auto-reply' may either refer to an automatic notification, in which case the service elements outlined above (i.e. 'delivery notification' and 'read notification') provide for the required functionality (the user can configure the UA to automatically honour requests for a receipt notification).
  If it refers to a reply, the 'reply request indication' service element can be used to request a reply message. It is again up to the recipient whether or not a reply is actually sent, and to whom. X.400 provides the functionality necessary to meet this requirement.

- **Mechanisms for directory synchronisation should be available.**
  Replication mechanisms may be used to synchronise different X.500 system agents. Thus, for a native X.500 environment the requirement is met.
  No specifications are available regarding synchronisation of proprietary systems with X.500-based system agents. Yet, this issue is outside the scope of international standardisation.

As can be seen from the above discussion, the vast majority of requirements are actually met by the standards specifications. As far as the scope of a standard goes, X.400 plus X.500 provide for most of the additional functionality required by users. Most of those currently not met are outside the scope of base standards, and can be attributed to either inadequate service implementations, lack of agreements between service providers, or need to be resolved locally. Only four requirements (out of forty-five, i.e. less than 10%) that actually address functionality to be included in the standards must be considered as not being met. Out of these, however, none is likely to be met by the specifications in the near future. Still, the predicted gap expected between user requirements and services provided by the standards could not be confirmed.

5.2 E-Mail Adoption

In the previous sections it was shown that - despite the popular view that standard IT-services do not adequately meet their users' requirements - even long-standing corporate users of electronic mail services are apparently not yet in a position to identify technical requirements that go much beyond the functionality provided by today's e-mail and directory services. One possible explanation is based on the assumption that systems have only been employed in the most simple way, i.e. as an interpersonal communication service complementing the telephone and facsimile.

It appears that until very recently e-mail has been little else than a convenient means for interpersonal communication for most large corporate users. Whilst this finding serves as an explanation for the absence of detailed technical requirements on the services, it may be interesting to look at the reasons behind this phenomenon. After all, one would expect that after years of service utilisation at least large, globally operating organisations would have moved beyond this simple use, and employ both, e-mail and directories, in a more sophisticated way.

Having solved the first puzzle only led to another, even more startling one: how can it be that even technically advanced organisations, operating on an international scale and thus being in urgent need of sophisticated communication services, after long years of usage still have not realised, let alone exploited, the full potential of electronic mail and directory services? This is all the more surprising if we consider that especially over the last ten or so years four crucial business trends have resulted in a dramatically increased need for seamless global communication:

- **Internationalisation**
  Moving into new markets requires adaptation to the respective dominant local system (as e.g. X.400 in Europe and the Internet in the US).

- **Integration**
  Companies are merging or being acquired, with a very high likelihood of resulting heterogeneous IT and communication environments.

- **Cooperation**
  The degree of cooperation even between possible competitors is increasing, again yielding the need for reliably working inter-company communication services.

- **'Virtualisation'**
  Virtual enterprises, i.e. temporary joint ventures of different departments or companies to achieve a certain, rather short-term goal are becoming increasingly popular.

For the business community each of these trends alone would justify an urgent need for global standards for communication services, enabling seamless communication both internally between different groups or departments and externally with business partners and customers.

Indeed, one of the major recent developments in the IT sector reflected these trends: the move from proprietary e-mail systems - almost exclusively employed until about the early eighties - towards 'open' systems - ie. TCP/IP or OSI-based communication networks in general and e-mail services in particular. Yet, these observations make the situation even more baffling: if organisations have realised the importance of open, standards based communication, why are its potentials still not fully exploited? Based on evidence obtained from the case studies it can be shown that this situation was almost inevitable, and that almost equally inevitably things will change in the not too far future.

Yet, there is a central dilemma associated with the organisational implementation of Information Technology (IT) today, concerning the relationship between the central and the local. On the one hand, the vision of the strategic application of IT advanced, for example, by proponents of Business Process Re-design [Ham 95], implies a centrally planned, top-down design and implementation of systems coupled to a radical transformation of organisational practice. On the other hand, research into IT implementations has revealed the importance of bottom-up strategies allied to local individual and collective learning processes in which technical potential is explored and fitted to the specific current and emerging requirements of groups of organisational end-users [Fleck 94]. The latter points to the contingency and heterogeneity of organisational information systems, viewed as complex configurations of diverse technologies and working practices. However, such a heterogeneous approach to IT systems remains problematic in relation to distributed IT systems, which exhibit strong network externalities, i.e. where the value for each user of being on the network increases with every new player joining the network. For example, if different local systems are incompatible, this will limit the benefits available from using the system.

For distributed IT systems such as electronic messaging services, two kinds of barriers to successful implementation may be particularly important. The one most commonly recognised is at the technical level of interoperability, where differences between various proprietary solutions or different generations of technology may mean that systems cannot interoperate or that some functions cannot be shared. However, another, potentially more significant barrier in terms of the cost and effort needed to overcome it arises from the commitment of end-users to their own locally-chosen systems -- which may represent a substantial investment made by large numbers of people to learning how to use a system and to apply its functionality to their working activities. This may result, for example, in a reluctance on the part of some end-users to comply with the imposition of organisation-wide, standardised services.

In the following I will categorise and describe the different strategies for the adoption and development of company-wide e-mail services as revealed through the case studies, and discuss their respective pros and cons. In doing so, it will turn out to be necessary to link these strategies to the respective previous history of messaging services, that is, to the situation that had emerged within each organisation before a corporate, centrally led system was imposed. It will become clear that in the vast majority of cases such a strategy was implemented only at a rather late stage.

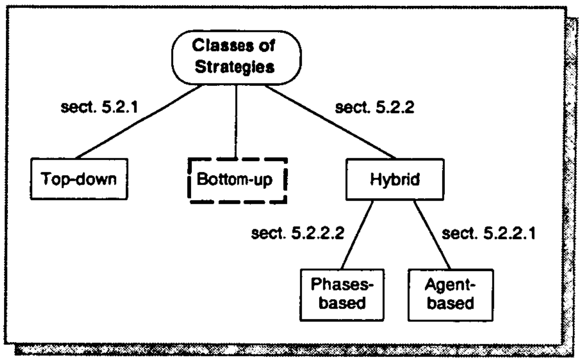

Figure 5.2.1: Classes of Introduction Strategies

Figure 5.2.1 shows the different development paths identified in the case studies. Only rarely was there evidence of a top-down strategy being followed throughout adoption and development (see also [Jak 94b], [Jak 96b]). The survey shows that it were either the smaller organisations, or particularly those that were 'born' into the Information Age which adopted this approach, often initiated by a top executive. In fact, in most cases a hybrid strategy could be observed, with a distributed and largely uncontrolled bottom-up phase eventually being succeeded by a centrally-led top-down phase. No examples of a pure bottom-up strategy were found, a fact that may most likely be attributed to the massive technical incompatibilities this approach is bound to produce, and which can only be overcome through centrally coordinated counter measures[101].

[101] Competing standards and technical specifications contribute to this situation, which could (theoretically) be avoided if only one standard were available. On the other hand, given the need for this standard to cater for a wide range of environments and applications, its sheer scope would inherently carry incompatibilities due to the various optional functionalities that would have to be offered. Basically, this happened to X.400.

5.2.1 Top-Down Strategies

The advantage of pursuing a top-down strategy right from the beginning of e-mail service implementation is that compatibility issues are more easily resolved and a solution providing homogeneous services throughout the whole organisation will be much more cost-effective. Also, the backing of senior management removes many obstacles.

> *"The decision to use electronic messaging was backed by the board of directors. Accordingly, the introduction brought at least very few organisational problems."* (company representative, 1994).

However, one of the major drawbacks of pursuing a top-down strategy from the outset is that it removes the opportunity for individual and organisational learning, which may have serious consequences for the success of the project [Atte 92]. This was also the experience of one of our case study organisations, where the introduction of e-mail was initially confounded by users' resistance to change. This resistance was itself directly linked to the fact that at that time the project began, e-mail's benefits were not really understood.

> *"In 1984, it was extremely difficult to convince people that e-mail was part of their job. People considered distributing information via e-mail as something vexatious."* (company representative, 1994).

Another, related effect was reported from another company, which experienced problems in terms of service utilisation.

> *"Generating usage. People tend to use voice mail."* (company representative, 1996).

This is not too surprising at all; there is little point in introducing a service for which no need has been identified on the part of the end-users. The same company reports that e-mail has been

> *"Moderately successful. Very useful."* (same representative, 1996).

Generally, the organisations which followed a top-down strategy from the outset were either the smaller ones, or relatively young organisations founded within the last twenty years.

> *"The company was lucky in that one of its founders was quite keen on IT, so funding has not really been a problem. In the early days, decisions related to information technology in general, and to e-mail in particular, were very much taken by this person."* (company representative, 1994).

Even in these cases, it was noted that following a top-down strategy only eased the introduction of the first system; subsequent moves, e.g. from mainframe-based towards LAN-based systems, still caused considerable problems, largely identical to those discussed below.

5.2.2 Hybrid Strategies

Overall, the results of the study suggest that large, international enterprises do not normally make top-down strategic decisions about messaging services from the very beginning. This result may partly reflect the structure of the case study organisations, the majority of which are subdivided into a number of almost autonomous companies or branches, located around the globe. The result was that end-users typically took the lead in e-mail adoption.

> *"Management plans, users do. Thus, ultimately we are bottom-up driven though us central guys pretend it's the other way around. Only rarely is it top-down."* (company representative, 1995).

Typically, I found that the early e-mail related decisions had been made at departmental or site level. As a result the initial messaging environments in the case study organisations were in most cases very heterogeneous. In general, this situation was at some stage aggravated by the existence of different generations of equipment, including mainframes, minis, workstations and an ever increasing number of PCs.

The consequence of this pattern of local, end-user led adoption on the one hand and the obstacles created by heterogeneous systems to interoperability on the other was the emergence of two distinct hybrid 'strategies' which combined elements of bottom-up and top-down strategies, but in rather different ways.

5.2.2.1 Phases-Based Strategy

The first hybrid strategy found holds for about two thirds of the organisations within the case study. In it, bottom-up adoption and top-down development strategies are pursued at different phases within the overall implementation process.

The Initial Phase - Introduction

In classical bottom-up fashion, a group of employees obtained a messaging tool, either to fulfil a specific work requirement, or, more or less coincidentally, bundled in with other software.

"The first e-mail system was installed as part of a major IT project, when it was merely considered a tool enabling cooperation between project teams in 17 European countries. Its introduction was part of the project roll-out, and based on a management decision." (company representative, 1994).

"Use of e-mail emerged from the use of VAX-mail, which came for free with the operating system." (company representative, 1994).

The new service became more and more popular. Slowly, mainly by word of mouth, information about benefits spread throughout the department.

"E-Mail started within 15 years ago as a tool for Human Resource clerks located at different sites to communicate with each other. It grew at the request of our scientists who wanted to communicate with collegues at other institutions. Executive management discovered it about 2 years ago. Development was bottom up." (company representative, 1996).

The number of users increased steadily, though still within the department or site, rather than at the organisational level. However, at the same time very similar developments took place at many sites, resulting in an extremely heterogeneous environment. Indeed, this (typical) outcome of the bottom-up approach was next to inevitable, since all departments purchased a system that best met their particular needs and requirements. At this phase mainframe-based systems were used, yet a few unix-based services were installed as well.

Due to the lack of any overall management, the situation outlined above was bound to last (i.e. continue to generate problems without sufficiently solving others), unless some central entity would take over. Users had recognised the need for integration as they experienced the problems of the incompatibilities between the patchwork of systems adopted at the different sites. In some cases, there were more than ten different mail systems installed, interconnected through a (not fully meshed) network of point-to-point gateways (see Figure 5.2.2). As a result inter-department messages had to be routed through several gateways. As gateways are rarely (if at all) able to map the full functionality of one system completely onto the capabilities of a different system, this led to sometimes significant losses in overall functionality; in extreme cases of incompatibilities it could even happen that some departments could not be reached at all from some others.

The resulting poor quality of inter-departmental communication quality was a major obstacle and often costly and frustrating for users. Thus, the conditions existed to justify the intervention of a central IT entity, which would subsequently pursue a top-down strategy to increase the benefits expected from a company-wide, smoothly operating and thus far more useful e-mail service.

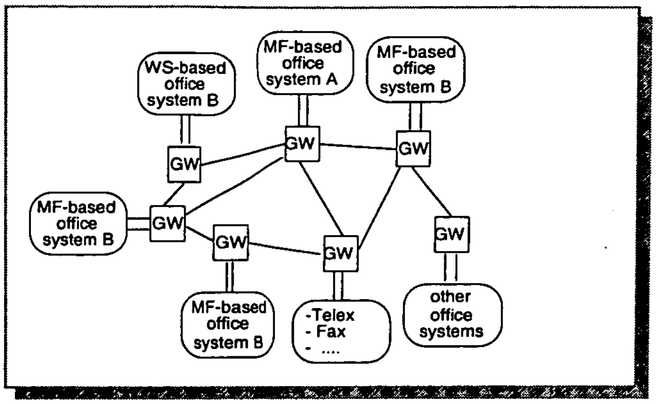

Figure 5.2.2: A Typical Environment at the End of the First Phase
MF = Mainframe, WS = Workstation, GW = Gateway

The Second Phase - Interconnection

At that time the case for following a central, top-down development strategy as a solution to these problems was very strong.

> *"[E-mail emerged] Isolated at different sites and then everyone had this great idea. Hey why can't the whole company use e-mail. Unfortunely, no-one architected the thing from the beginning -- this is changing."* (company representative, 1996).

Unfortunately, its acceptance depended upon senior management being convinced that the major expenditures necessary for purchasing, installing and maintaining a (more or less) homogeneous e-mail service were justified by the benefits.

> *"Funding at times has been a problem. Management did not believe that a mail system this large required yearly funding for training and upgrades. I was able to get a budget for the last two years and the system has improved a thousand fold. Errors dropped from 1240 a month to 20 in one month."* (company representative, 1996).

Eventually, attempts to establish a top-down development strategy started: a central entity[102] tried to integrate the different services with management backing.

> *"Originally it was an effort led by techies, now it has much management support."* (company representative, 1996).

102 Typically the central IT or IS (information systems) department.

In contrast to the initial service introduction, this consolidation was always part of a centrally managed and organised top-down development strategy, which aimed at

- the establishment of a homogeneous, company-wide backbone replacing the collection of point-to-point gateways,

- the reduction of the number of locally used systems to an acceptable level.

The former was a comparably straightforward task; the point-to-point gateways had to be replaced by either an Internet- and/or X.400-based backbone, or by a central multi-protocol converter.

> *"7 independent Email systems evolved into the 4 integrated networks we have today. One major system - mainframe based CA-Email - was migrated directly to cc:Mail about 3 years ago."* (company representative, 1996).

Regarding the latter, the ideal situation of just one company-wide e-mail front-end system (i.e. user agent) could not realistically be achieved. This was primarily due to some groups with very specific functional requirements.

> *"We have consolidated to 4 Email systems, fully interconnected: cc:Mail, representing over 1/2 our installed base. The other 3 are Lotus Notes, primarily used by the field sales force and marketing, SMTP, used by Engineering, and DEC Pathworks used in many of the factories."* (company representative, 1996).

As this was a centrally initiated move, problems similar to those experienced by companies that pursued a top-down strategy from the outset surfaced at this point. That is to say, resistance to change on the users' side turned out to be an important issue. Two large companies in the case study reported that they experienced such problems during the company-wide e-mail roll-out. Asked to indicate the major problems encountered during this phase, they explicitly stressed 'user acceptance' in addition to the more obvious issues such as for example convincing management:

> *"All of the above* [convince management, get funding, technical issues], *but the biggest was inherent resistance to change and fear of new technology."* (company representative, 1995).

These problems occurred despite - or maybe because of - the fact that the first introduction of e-mail at departmental level had been entirely user driven.

"All of the above [convince management, get funding, technical issues]. *Add in user acceptance, integration, ease of use, similarity to systems users already familiar with, etc."* (company representative, 1996).

This quote hints at a problem that must not be underestimated - there is little point in pushing a new system or service, even if it is significantly superior in technological and/or organisational terms. This holds although it slows down the introduction process even further.

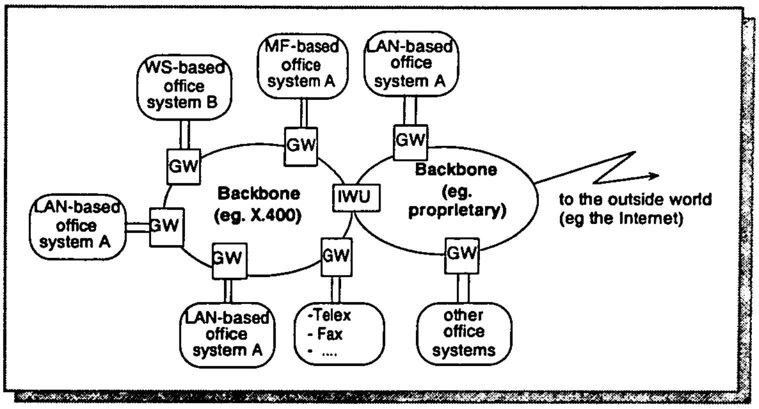

Figure 5.2.3: A Typical Environment at the End of the Second Phase
MF = Mainframe, WS = Workstation, GW = Gateway, IWU = Interworking Unit

Figure 5.2.3 depicts part of a typical e-mail environment once the consolidation phase had been finished. The typical scenario comprises a limited number of different systems, which are interconnected by one or, more commonly, a small number of backbone networks, which in turn were interconnected through dedicated Interworking Units.

"We use a centralized integrated messaging architecture which includes an X.400 backbone, a message transfer agent (MTA) which routes messages between E-mail systems, gateways to the various messaging systems, an extended LAN facility (ELF) to exchange messages between similar LAN E-mail systems, and a global directory service that synchronizes changes nightly." (company representative, 1996).

Also at this phase most organisations started looking at more flexible and feature-rich systems, which they typically found on either PC- or Unix-based systems. Another development supporting this migration was the then popular general move away from mainframe machines to smaller systems. Whereas there has been a general trend towards a higher degree of service distribution, this has been achieved via different evolution paths (see Figure 5.2.4). It must be noted that companies may have followed different such paths in parallel.

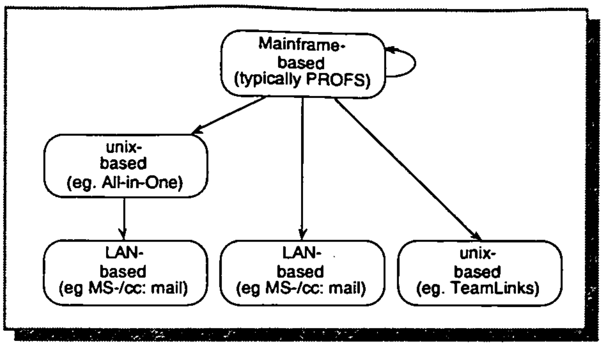

Figure 5.2.4: Typical Evolution of Electronic Mail Service Platforms

Quite a few companies seem to be satisfied having reached this stage and have no plans (for the time being) to push integration any further. Others, though, (intend to) move on.

The Third Phase - Interoperation

This phase, which some of the case study organisations are currently pursuing, is a continuation of the top-down development strategy, and is characterised by the attempt to introduce an almost uniform local e-mail environment (typically utilising e.g. MS-Mail or cc:Mail), interconnected through one messaging backbone (typically an X.400-based system or the Internet), which also offers access to the respective other e-mail world (i.e. the Internet or X.400, see Figure 5.2.5). Completion of this step means that a homogeneous service will be available for most users, and that the number of different gateways will be minimised.

> *"Until we've got to the stage we've got an entire user population on one e-mail system we're going to have a degree of user annoyance."* (company representative, 1994).

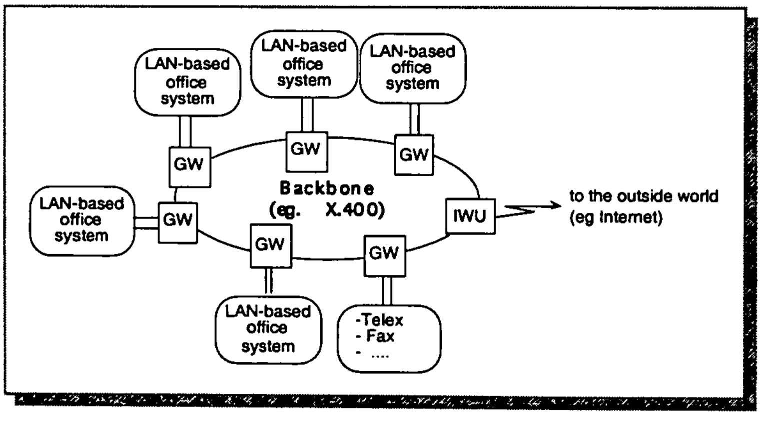

Figure 5.2.5: The Envisaged Final Stage of the Process

Whilst this may be an unrealistic goal for the time being, there is no doubt that this statement is true. As has been noted earlier, interconnection of different mail systems via gateways always leads to a loss of functionality, which in turn will frustrate affected users. Some of the case study organisations have gone to great lengths to push forward an architecture similar to the one depicted above, employing LAN-based systems interconnected through one homogeneous backbone. This move, which is still far from completed in most companies, typically also resulted in some problems, including:

- **Convincing management**
  The establishment of the first e-mail systems was achieved fairly painlessly and without major financial expenditure. However, convincing top management that a move from an apparently well working service towards something new was typically quite difficult.

- **Service uptake**
  Despite their various advantages, LAN-based systems incurred a considerable extra overhead compared to centralised mainframes, including for example additional local administration staff, extra management tasks, and directory synchronisation.

- **Convincing users**
  Once staff got accustomed to using to a certain service, organisations found it hard to persuade them to use something else instead. This was even more the case if the new service was still in its infancy, and likely to cause problems for some time.

- **System interconnection**
  There was almost universal agreement that a single, company-wide e-mail service was the best solution for organisational messaging needs. However, this proved to be very difficult to achieve in practice. Consequently, most organisations have opted to establish an interconnecting (and integrating) e-mail backbone instead.

Popular envisaged future steps which will eventually lead to a closer integration of e-mail into business processes, and thus a better utilisation of its capabilities, include use of an X.500 based directory service and the move towards an increased use of electronic commerce.

"Future plans for the corporate mail system in 1996 include the installation of an X.500 directory that will assist in the directory synchronization effort. In early 1997, X.400 will be installed to permit seamless communication with the diverse systems of external partners. The X.500 directory will be the foundation for electronic commerce and electronic signature in late 1997. By early 1998, cc:Mail will be the mechanism for the transmittal of invoices, receipts and payment of bills." (company representative, 1996).

The Next Phase - Integration

Developments like those outlined above are most likely to be observed in many companies, especially the very large ones, with the most urgent need for a seamlessly working global IT-infrastructure. As a result, it may be anticipated that e-mail will gain additional importance, and that its usage will increase significantly. In particular, as a first step towards more sophisticated usage mail enabled applications are likely to be become increasingly important.

"Yes to your initial list [interpersonal messaging, mail-enabled applications like eg. EDI and groupware] *and also add in calendaring and scheduling. Really, Email is generally useful."* (company representative, 1995).

Whilst thus far the single phases occurred virtually sequentially over time, this phase seems to overlap in part with the previous ones, in that mail-enabled applications are used over a still rather heterogeneous underlying e-mail infrastructure.

".... I think the total protocols we support is around 12. Currently we have four Email backbones: SMTP, Message Router, X.400, and SNADS. We are in the process of forming a corporate Email infrastructure based on two backbones: X.400 and SMTP/MIME." (same company representative, 1995).

However, the major characteristic of this phase, which makes it stand out from the others and, indeed, defines it, is the recognition of e-mail as a strategic corporate tool. Thus far, only three of the case study organisations have at least partly progressed to this stage, in that they consider e-mail as being mission critical and as a strategic tool in its own right, and as an enabler of strategic applications.

"We have a corporate-wide Email strategy with tactical and strategic plans and several important projects currently running. Email is beginning to be viewed as an important tool for accomplishing business processes. That is why we have emphasized it so." (same company representative, 1995).

It should be noted that this company, despite being 'only' a user, has long been a major player in the data communications field. Even such a leading edge user, which has recognised the business potential that lies in the use of e-mail, and who started phase two in 1987, has not yet completed this phase. This again points at the tremendous problems that come along with e-mail introduction and implementation. A similar situation can be observed at another early adopter, who states that

> *"Email is our only corporate wide electronic application and our most mission critical computing capability."* (company representative, 1996).

Despite the degree of importance attributed to e-mail this company too is still using different e-mail systems and is only about to start using mail-enabled applications.

> *"LAN based IPM is the primary usage. Just starting to deploy MEAs."* (same company representative, 1996).

It may be concluded that it is a very long way from the first adoption of e-mail in an organisation to a stage were its full potential is entirely exploited. Thus far, it appears that none of the companies represented in the case study has yet managed to do so, although some of them must be regarded as leading-edge users.

5.2.2.2 Agent-Based Strategy

In contrast to the first hybrid strategy, where bottom-up and top-down strategies are pursued sequentially and contingently, the second hybrid strategy that could be identified integrates the two in a systematic and pre-planned way: bottom-up adoption is steered and controlled through a parallel, overarching, top-down implementation strategy [Jak 94b].

Use of this strategy was for instance observed within a large French chemical group. Sales staff and a special communications group where the first to be involved in the project. A simple adoption strategy was followed: people known be interested in trying and testing new techniques were persuaded to use the new e-mail service. Those people - the agents - then had something like a catalyst function within their respective departments, serving to promote the further introduction of the system. Messaging could be demonstrated as being an attractive service. Yet, it was always made very clear that messaging was not intended to be a replacement of other established communication media, but an additional service, and that messaging would be as easy to use, and at least as effective as other communication services. Stressing these facts was considered crucial, as gaining users' confidence has always been a vital part of the internal marketing strategy.

Eventually, management and other senior personnel learned about the benefits of e-mail, largely by word of mouth. Once these people were enthusiastic about messaging, it became an important tool in their departments within very short time. It turned out that people suddenly found they had various obligations that forced them to use e-mail. In fact, this was simply because colleagues or superiors were using the system. This development was supported by group meetings, where messaging benefits had been presented, with senior staff sharing their related experiences. Such private success stories and experiences, as well as concrete business cases, contributed significantly to the system's further uptake.

This hybrid approach is of particular interest because it represents an attempt to combine the advantages of a pure top-down implementation strategy - i.e. its speed and resulting homogeneity - with the advantages of a bottom-up adoption strategy - i.e. the opportunities for organisational learning - but without the latter's disadvantages - i.e. the problems of incompatibility. However, judging by the outcome of the case study, this approach is not too widely used.

5.3 Summary and Analysis

One of the assumptions underlying this thesis was the notion that functionality provided by today's specifications of electronic mail systems is inadequate and fails to live up to actual user needs and requirements. To verify this hypothesis, user requirements on two sample services, electronic mail and the directory service, have been compiled and subsequently been matched against functionality actually specified in the standards.

It turned out that very few of these requirements go beyond what is already provided by today's X.400 and X.500 series of recommendations. This holds particularly for those requirements gathered from various literature sources, the majority of which were specified a-priori, that is, they have been identified prior to actual usage of the service. It is little wonder that such requirements remain particularly sketchy, focussing on rather general issues such as reliability, reachability, provision of distribution lists, or security features.

Thus, despite the original assumption of inadequate standard functionality, it does not come as too much of a surprise that so far the functionality necessary to meet many identified user requirements is included in the standards. In fact, most of those requirements that are not met are outside the scope of any standardisation, in that they relate either to functionality to be provided locally (as e.g. virus checking), or to user behaviour (as e.g. in the case of up-to-date directory information).

Only four out of forty-five identified requirements must be considered as being within the scope of standardisation, and as not being met. Out of these, the requirement for messages and notifications to be delivered within a predefined time is partly implementation dependent: the standards fail to specify a hard upper time limit for messages traversing through several interconnected domains. However, delivery times largely depend on the actual load situations in the networks and the MTAs, and on the bandwidth and computing power available. Thus, in practice little more can be done to accommodate this requirement. Not unlike the above requirement the need to be able to specify mandatory routes is met to some degree. The predominant reason for preferring one route over another are security-related considerations. As it is possible to exclude MTAs that do not meet user-defined security requirements from being traversed by a message, it is at least possible for a user to define security levels in such a way that a sufficiently secure route can be guaranteed. Finally, having messages delivered as soon as possible after expiration of the delivery time limit is the only requirement that is indeed not met by the standard. While it would be comparably easy to include a service element enabling this functionality, it remains to be seen whether sufficient support to actually include this functionality will be available.

It should be noted here that all requirements not currently met originated from the requirements compilation produced by EEMA [EEMA 96], and therefore belong rather more to the second group of requirements, i.e. those compiled through interviews with corporate users.

On the other hand, it should also be noted that this requirements list does not include anything that is next to impossible to meet, dreamt up by users who simply do not understand - or care about - the technology and thus tend to demand whatever they feel might perhaps be useful. Complaints about such user behaviour are not completely unheard of, and have often been made by standards committee members (a detailed discussion of this issue, and related topics, can be found in chapter 6). At least in this case, such complaints are unfounded.

In terms of sketchiness the requirements compiled from literature as discussed above are not too much different from those identified by long-standing users of corporate e-mail systems. They too exhibit a level of cursoriness that is in this case quite surprising.

The identified need for user-friendly addresses (a valid requirement despite the fact that O/R-names are supposed to be user-friendly) is justified, largely due to the fact that O/R-addresses were originally designed to support routing decisions (and thus carry routing-related information, as e.g. the 'ADMD' part, which is meaningless otherwise), and that directory names, which may also form an O/R-name, can neither be considered as being particularly user-friendly (cf. e.g. [Jak 90b], [RFC 95b]). With one exception, the other requirements can only be met through local implementations (editing facilities), service implementations (understandable error messages, domain interconnection), or additional tools (directory synchronisation). As for the need for 'auto-replies', which would actually be provided if the standard were fully implemented, the problem may be that they either need to be explicitly requested on a per-mail basis ('reply request indication'), a fact possibly unknown to many users, or, alternatively, that sending a receipt notification to indicate that the message has actually been read is at the discretion of the recipient, and may thus not necessarily always be done.

Despite being somewhat sketchy, the above requirements are generally valid. The frequent mention of other, more trivial requirements (notifications, security, etc), however, comes as the real surprise. It may be concluded that at least some service providers have not implemented the full standard. Indeed, typically only those elements of service have been implemented that are classified as 'essential' in the standard, excluding most of those features that serve to make a messaging system more user-friendly and useful[103]. In particular, this holds for all security-related service elements, which have so far been implemented by less than a handful of vendors.

Whilst the above may help to explain why experienced users still consider such evidently trivial requirements as not being met by today's e-mail services, it does not go into the problem why even supposedly sophisticated users apparently do not have any further, more specific requirements.

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[103] In addition to that, charging may be an issue. Some corporate users may prefer to save some money and not to subscribe to all elements of service actually availalbe from a provider.

To solve this puzzle it was helpful to look at the current state of e-mail exploitation in organisations, and the underlying typical history and development of corporate e-mail systems. The degree of e-mail usage, the sophistication of mail-enabled applications in use, and corporations' judgements regarding the strategic importance of electronic mail provided valuable insight as to why no more detailed requirements are available.

The vast majority of companies in the case study share a common past in terms of e-mail implementation. They typically experienced a distributed user-led bottom-up approach resulting in a variety of different messaging systems, that at some point had to be integrated through a centrally designed and implemented backbone network. This happened around the mid to late eighties. From then on, e-mail implementation has been under corporate control and management, and further developments have been directed by central IT or IS departments.

So far e-mail has almost exclusively been used for interpersonal communication in many companies (apart from maybe scheduling and calendaring, which have been around for a while). Only recently have more sophisticated uses of the service got of the ground, and early adopter companies have been looking closely at mail enabled applications for some time[104].

In general, the dilemma between centralised top-down and distributed bottom-up strategies for system implementation is perhaps unavoidable in very large, multi-divisional organisations trying to employ new and evolving technologies. For instance, it has been pointed out (e.g. in [Boyn 87]) that departments and other sub-units are positioning themselves closer to their information resources in an attempt to circumvent central IS. As a result departments hope to minimise coordination costs between supplier (central IS) and user (themselves) of IT. Moreover, with information technology increasingly being perceived as easy to use even for non-specialists, and with hardware prices dropping steadily, inclination rises on the side of departmental managers to have their own staff design and develop tailor-made applications. As a

[104] In terms of corporate visions regarding IT infrastructures most companies still belong to types one or two (i.e. their infrastructure developments are not related to, or shaped by, the company's strategy). Only the very few sophisticated users which have fully realised the importance of an adequate infrastructure might be categorised as 'type 3', that is, their strategy and IT infrastructure development are interrelated.

logical consequence end-user computing[105] has emerged more recently in most companies, and has established itself as a top priority for IS managers [McLean 93], with related management issues becoming more and more important as well (see e.g. [Bran 93]). One reported consequence of this development is *"... a shift in the primary function of the central* [IT] *organization from systems design and development to systems integration and from the role of developer to that of advisor."* [Clark 92]. This is exactly what could be observed in the case study companies, where integration of heterogeneous e-mail systems had been the major task of the central IT departments.

Characteristics of the recent trend of end-user computing to a considerable degree resemble the situation that arose during the first phase of the e-mail introduction process. It may be concluded with some justification that this first phase in fact represented an early form of end-user computing, although none of the interviewees actually put it that way. Indeed, a department installing the e-mail system that suits its needs best is well within the scope of the definition of 'end-user computing'. However, whilst this approach is perfectly valid on the purely local scale, it does not take into account company-wide implications, which may indeed not be foreseeable at all at the time of implementation. In consequence, problems in terms of incompatibility and heterogeneity are likely to occur eventually at the corporate level. If and when this happens, central IT will be called upon for systems integration [Dods 96]. Even if this were the accepted major task for a central IT department, early planning, issuing of guidelines, and requiring use of standardised components from the early stages on, which would only marginally interfere with the single departments' freedom of choice, could help avoid a lot of problems later. Against this background, insights gained especially from studies of introduction strategies of interactive services (such as e-mail) - and the subsequent development - may attain additional relevance.

On the other hand, the findings of the case studies also suggest that the influence of managerial planning on departmental decisions regarding e.g. questions like 'which e-mail system shall we use?' and 'how can we put e-mail to good use?' should not be over-estimated. In many cases, purchase and subsequent use of e-mail systems just happened, almost by accident (similar developments have also been reported in e.g. [EEMA 94a]). In one company, for example, e-mail came for free with the newly purchased operating system, for another it came bundled with a word processor for

[105] "End-user computing may be defined as the adoption and use of information technology by personnel outside the information systems department to develop software applications in support of organizational tasks." [Bran 93].

secretarial staff; subsequent increase of usage was achieved mainly by word of mouth (i.e. bottom-up) rather than through dedicated departmental strategies (i.e. top-down).

While extra problems at the corporate level are likely to surface through end-user computing, measures to limit experimentation with new technical alternatives to centralised functions would act as a barrier to innovation by reducing the scope for individual and organisational learning. This is, for instance, one of the reasons why large bureaucracies in public administration were much slower than e.g. manufacturing organisations in successfully adopting distributed computing [Adler 92]. Management responses to end-user computing have been characterised variously as 'monopolist', 'laissez-faire' and 'managed free economy' [Gerri 86]. The evidence of our case studies points to the apparent domination of laissez-faire strategies which, as we have seen, leads to major problems once organisations are forced to grasp the nettle of interoperability and system incompatibilities.

Of the alternatives, a better strategy than the monopolist approach of suppressing locally-generated innovation, might be to develop policies that cater for it, and allow it to be fostered within a more overarching strategy. An example might be the agent-based strategy identified in the case studies, where seemingly local innovations were pushed and, in fact, guided through a central entity. This approach was considered highly successful by those in charge [EEMA 94a]. Similar strategies involving 'change agents' are also known from the literature [Rog 95]. More specifically, given the importance of compatibility to services like e-mail, it might be useful to encourage local innovations on the condition that the need for migration strategies to eventual organisation standards is addressed. This might, for example, involve giving preference to systems built on open standards, possibly including proprietary industry standards that have been opened out to complementary suppliers, and especially to 'architectural technologies' where some elements of a product remain constant, providing some guarantee of compatibility over several product generations [Morris 92].

Chapter 6

Users and Standardisation

This chapter will first introduce a brief - and, as it turns out, simplistic - initial attempt to describe the standards setting process in sect. 6.1. A discussion of the relation between the different stakeholders in this process will lead to a more realistic description, which will also draw upon comments made by standards setting professionals on the process they are involved in. Committee members will also get a chance to speak about their views on perceived potential benefits and drawbacks that may lie in an increase of user involvement in the standardisation process, as will representatives of large corporate users. Their respective views will be reported in sect. 6.2. Finally, in sect. 6.3, I will give some explanations for the reluctance on the side of the latter to commit resources to standards setting activities, and propose some ways of how and when meaningful user participation could be achieved. This will be in contrast to some commonly held beliefs regarding the desirability of user participation in standards setting.

6.1 Perception of the Standardisation Process

Thus far only the rules and regulations governing the different bodies' standards setting processes have been addressed (section 4.1). Yet, such policies largely describe the theoretical ideal situation, not necessarily how things work in reality. Moreover, to a considerable extent they focus on the overall standardisation process rather than the specific part of this process dealing with the technical work going on in the single work groups. Therefore, these official rules need to be complemented by a description of the course of work that can actually be observed within these groups.

The following descriptions and discussions are therefore based on the perception of work groups' members. Prior to that, however, a naive idea of the standardisation process is briefly outlined and discussed; it represents the view a layperson might have, and thus forms the logical starting point for all further deliberations.

6.1.1 The Starting Point - The Official Version

The various procedures adopted by the different standards setting bodies may well lead to the assumption that the degree of control over, and influence on the standards setting process is about equally distributed between the different stakeholders (including vendors, service providers, the government, and users). This, in turn, yields the model of the standardisation process as depicted in Figure 6.1.1. It shows the 'ideal' situation, with all stakeholders having a (more or less equal) say in the standards setting process. It assumes that interested parties meet, compile and review their - possibly only anticipated - needs and requirements, define the best technical approaches and mechanisms realistically feasible, and eventually come up with a standard that should survive in the market and should pretty much suit all needs.

Indeed, this model reflects the technocratic view apparently quite popular with the standards setting bodies themselves. It can easily be derived from the descriptions of, and rules for the 'official' processes (see also section 4.1). Unfortunately, it does not capture reality as non-technical (i.e. organisational or social) aspects are ignored. In particular, it does not assume any links or interrelations between the different stakeholders apart from the common work in a committee.

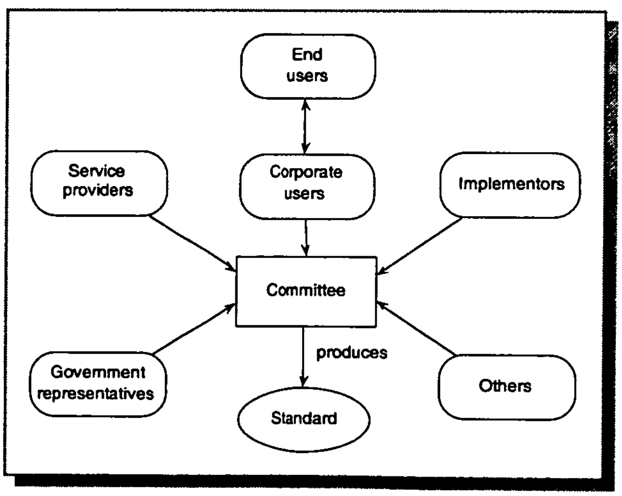

Figure 6.1.1: The Naive Idea of an Ideal Standards Setting Process

However, this ideal scenario is far removed from reality. In fact, it appears that so far, development of communication services has almost exclusively been technology driven; services offered tend to solely reflect the providers' and/or implementors' priorities, like, for example, manageability rather than usability (for a similar judgement see also [ITU 94a]). This can largely be attributed to the fact that relevant standardisation committees have typically been dominated by vendors and service providers. Asked what kind of organisations are represented in the committees, and which are perceived as being the most dominant ones, the responses were pretty much unanimous. In the words of members from four different organisations[106]:

> *"All kinds of organizations are represented - and, in fact, strong measures are taken to get wide representation. However, end user participation is generally quite small - it is hard for an end user to make the economic commitments necessary to be a successful player in standardization."* (ANSI committee member, 1995).

> *"Manufacturers, PTTs, Governments, and research institutions dominate more or less in that order within the committees on which I served."* (ITU committee member, 1996).

> *"Manufacturers and service providers (including standard's consultants) are the major participants; it is too expensive for small companies and user groups to attend and commit the resources necessary for effective participation (one cannot be effective in standards development and only attend part-time)."* (ISO committee member, 1995).

> *"I am primarily interested in the applications area. The subsets of the working groups that actually do the design and documentation work, in general come from the manufacturing community. Participants not representing implementors tend to come and go and rarely involve themselves with the design teams."* (IETF work group member, 1996).

These brief quotes, which are representative of the committees considered in the case studies, already suggest that

- the original model is in need of some modifications, and that
- insufficient resources on the users' side is a popular explanation for this situation.

The former is beyond doubt, and will be elaborated on in the following sections. Regarding the latter it remains to be seen whether it actually represents the correct interpretation of the current situation.

[106] Please note that all quotes obtained through questionnaires will be reproduced as they were received (except for some editorial abridgements, which will always be clearly marked).

6.1.2 A More Realistic View

After having dismissed the view outlined above as being overly simplistic, the following sections attempt to provide a more realistic description.

6.1.2.1 Relations Between Stakeholders

The major stakeholders in the overall standards setting process are easily identified. As already depicted in Figure 6.1.1 above, they include users, vendors, service providers, and the government. This list of stakeholders is pretty much in line with those identified by other sources (see e.g. [Ferné 95], [Fisch 90]). At the technical work group level, however, the picture looks slightly different. Here the government, for instance, is little else than another corporate user (see also [Salt 96]).

Obviously, there are also relations between these various stakeholders outside the standards setting process, the most obvious one being customer - supplier (i.e. users of services - users of standards). Those relations may well have considerable impact on both sides' activities and conduct in standardisation. For instance, it would seem - in contrast to the assumption outlined above - that users consider that talking to their system vendors and/or service providers, and buying products that meet their immediate needs, as being the most effective and convenient way towards establishing a useful messaging system, rather than getting involved in setting standards.

> *"We do talk to our vendors quite a bit, if you like, they're proxies for us.... They probably sit on the committees..... They can say their customers are asking for this... You hope the vendors and service providers do actually listen to their customers."* (user representative, 1995).

As has been discussed in sect. 5.2, the typical corporate e-mail environments of today still show a - sometimes considerable - degree of heterogeneity. Whilst a completely homogeneous environment will probably never be achieved, the general trend is towards more homogeneous LAN-based e-mail systems. Accordingly, there are customer - supplier relations between users and vendors of such systems as well. These single systems need to be interconnected to the outside world. This can either be outsourced to a service provider (see above), or be done internally using a (virtual) private network and interconnection equipment purchased from appropriate vendors. In the latter case, a vendor's market share, and actual market presence, are important factors influencing users' decisions on what to purchase. Asked for the initial criteria for the e-mail system of choice, for instance, a typical response was:

> *"Very much a point in time decision. If we had made the cc:Mail decision 2 years earlier we would have gone with Novell MHS. If we had made it 2 years later we would probably have gone with MS-Mail."* (user representative, 1996).

This comment suggests a certain 'follow the leader' approach; the choice of a corporate LAN-e-mail system depends on who is the market leader. In particular, this aspect appears to be considerably more important than criteria like e.g. adequate functionality or potential for integration into the existing environment. In general, users represented in the case study to a considerable degree rely on their service providers and vendors. According to one provider requirements specifications are not normally provided. If requirements had actually been compiled major issues included the comparably straightforward aspects of pricing, the level of help and support available, transmission speed, network monitoring, and quality of service. This reliance is very much in line with the recent trend of IT outsourcing, a discussion of which is well beyond the scope of this thesis.

A user's relations to business partners and customers also appear to play an important role when it comes to purchasing an e-mail system.

> *"We selected Microsoft mail because a major customer had it, and we were able to interconnect our e-mail systems."* (user representative, 1996).

Improving communication links with customers or business partners is a strategic goal. Yet, the simple (tactical) solution described above - i.e. to buy the same LAN-based system a customer has and to interconnect them somehow - will not necessarily yield the best overall solution nor will it improve a user's incentive to think in longer terms, since this goal is still based on a short-term decision (i.e. to buy a certain system) enabling only the required ad-hoc solution (not to mention the problems that arise if another equally important customer happens to use a different system).

The positions outlined above become somewhat more understandable if you consider the typical pattern of adoption of corporate e-mail so far (see sect. 5.2). Yet, if these were really major factors influencing purchasing decisions - and the responses from users seem to point into this direction - this could at least partly explain users' reluctance to go that extra mile and participate in standards setting. At the same time, it demonstrates a severe lack of strategic thinking on the user side. On the other hand, it still leaves open the chance of increased future interest in standardisation activities if and when e-mail plays a more important role in the business environment [Jak 96g].

As noted earlier, most organisations are currently using LAN-based e-mail systems as their front-ends, and use X.400 or the Internet only to interconnect these local networks. Thus, at least from the end-users' point of view, these wide-area systems are hidden behind the respective local systems and their interfaces. This, in turn, once again (at first glance) reduces the need for standardised services as provision of adequate functionality appears to rest with the vendor of the LAN-based systems. Accordingly, product user groups (for LAN-based mail systems) are another popular means to exchange information and convey requirements. Membership in such groups, whether product specific (as e.g. for MS-mail) or related to a certain class of services (as e.g. EEMA) serves a similar purpose as do direct talks with vendors, but offers the additional benefit of regular information interchange with other users.

> *"We are members of the Microsoft Mail user group. We do seem to get benefits from user groups. We seem to get major benefits from meeting an talking to people that have been in the same situation."* (user representative, 1995).

Established user organisations, such as EEMA, are perceived by many as potential future representatives of users in standards setting bodies. To quote one interviewee, the most appropriate way for his organisation to promote standards-related issues is

> *"Via participation in the EMA and in messaging conferences - giving papers, publishing, participating in working committees."* (user representative, 1995).

In fact, EEMA has recently been deliberating whether or not to become active in this area. It should be noted that this would not be without precedent, INTUG[107] has long been representing users, especially in committees of the ITU (though apparently not too emphatically in the technical work groups; no representatives from INTUG were active in the groups studied). Figure 6.1.2 summarises the relations that typically exist between different stakeholders in the standardisation process. This picture emerged from the case studies.

Given the (realistic) perception of costly, cumbersome and time consuming 'official' standardisation processes (i.e. those embraced by ISO and ITU), which bring no guarantee of success, it may not be surprising that users seek alternative ways to communicate their needs to those entities they feel are in charge of meeting them.

[107] The International Telecommunications User Group.

Surely users want the immediate benefits of currently available systems rather than to forego these in favour of possibly better future systems.

> *"We are much wiser about the value of standards than we were in the '80s. The promises never became reality. This is one reason we focus much more on market/de facto standards rather than de jure "paper tiger" standards."* (user representative, 1996).

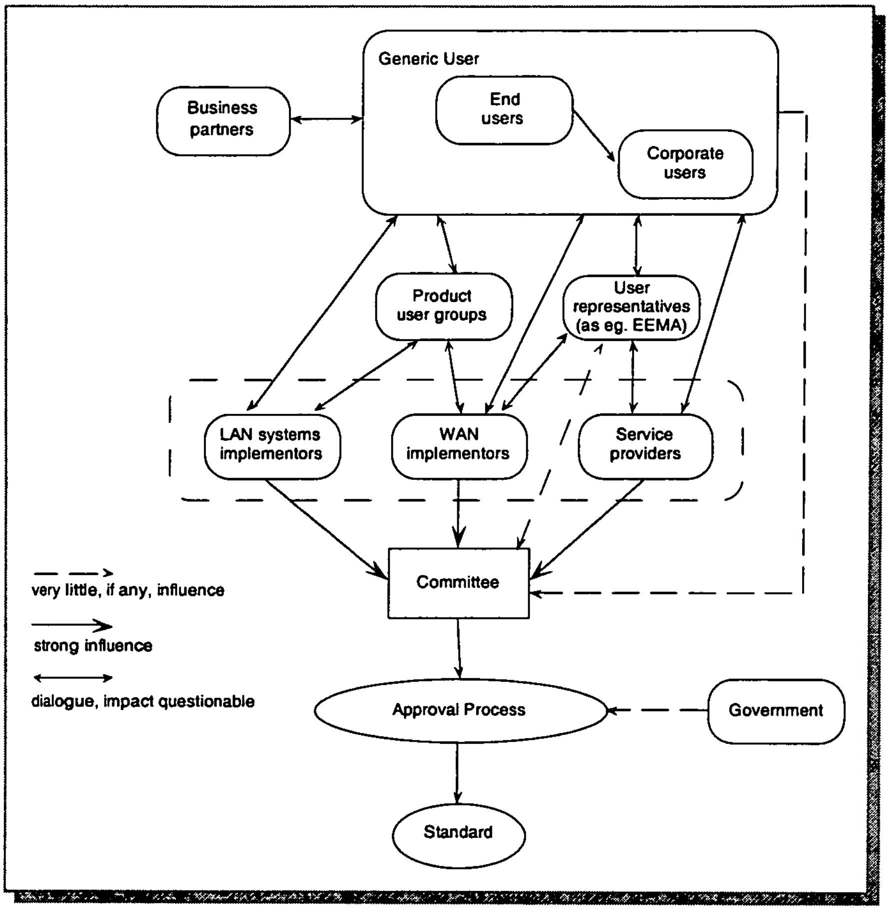

Figure 6.1.2: Relations Between Stakeholders
(Reflecting the actual situation in the technical work groups)

From Figure 6.1.2 it could be concluded that implementors and service providers (deliberately or not) act as a 'buffer' between users and standards committees. One potential result might be that at least some user requirements simply do not make it into the standardisation process because of this 'buffering' phenomenon. Worse, helping customers (the users) to resolve short-term problems in an ad-hoc manner implies that established processes and procedures are being bypassed for the sake of a quick solution. Whilst this approach helps users solve urgent problems quickly (a point which must not be underestimated), it still remains a short-sighted short-term approach. As the 'bypass effect' accumulates there is a real danger that the standardisation process will be undermined, and that at the end of the day users are locked in to enhanced, but mutually incompatible systems. This, in turn, means that they are virtually stuck with their respective vendor. One of the ideas behind the development of open systems was to help users out of precisely this situation. Another potential result is that such ad-hoc 'solutions' may lead to additional functionality added to local implementations (eg. User Agents) rather than global functional enhancements, thus again causing system incompatibilities.

The approach outlined above - i.e. to put some more functionality into the local system in an attempt to circumvent inappropriate functionality of the underlying system - has reportedly been adopted very successfully by one of the users in the study. In the words of an interviewee:

> *"I don't think we have any issues. If we did have an issue, we would probably fix the problem ourselves, as we have done with confirmations on the Internet."* (user representative, 1995).

This is also a development envisaged by one of the large service providers, which sees future very high-level communication services being based on peer-to-peer arrangements rather than globally agreed services and standards.

> *"For transactions which reall do require an acknowledgement than its quite simple: You just use your OSI communications model and you build an application to application acknowledgement protocol.* [...] *It won't be long before somebody commercially comes up with a whole set of stuff that actually works with a few big customers connected to it."* (service provider representative, 1995).

It remains to be seen if this will really happen. If it does, it will be a step in the wrong direction, and it will also put a big question mark behind standardisation as such. Moreover, there is a real danger that such bilateral activities would ultimately decrease the overall value of the system, as interoperability with other systems would be severely hampered and the influence of network externalities would diminish.

In summary it may be stated that established consumer-supplier relations between the different stakeholders in the standardisation process, and the resulting chance to get (proprietary non-standard) solutions fairly quickly, form a major barrier to user participation in standards setting. However, as participation in user groups (as e.g. the MS-mail user group) is also considered very useful, and as user groups become increasingly involved in (pre-) standardisation, this may be used as a vehicle to convey user input to the relevant committees.

6.1.2.2 Work Group Members - Characterising the Respondents

Before pursuing a more detailed description (and subsequent discussion) of the standards setting process, some more information on the background of the respondents might be beneficial.

It seems that chairpersons, project editors and rapporteurs (the more senior committee members, i.e. those who are represented in the survey) form a caste of 'standards professionals'. The vast majority of respondents have been active in the field for a considerable time in various positions (see Table 6.1.1). Indeed, it appears that at least the 'official' bodies ITU, ISO, and ANSI are dominated by particularly long-standing members (it remains to be seen whether this is good or bad).

	0-4 years	5-9 years	10-14 years	>14 years	Total
ITU	0	8 (32%)	13 (52%)	4 (16%)	25
ISO	0	8 (57%)	5 (36%)	1 (7%)	14
ANSI	1 (7%)	4 (29%)	3 (21%)	6 (43%)	14
IETF	8 (50%)	7 (44%)	0	1 (6%)	16
Total	9 (13%)	27 (39%)	21 (30%)	12 (18%)	69

Table 6.1.1: Respondents' Association With Standards Bodies[108]

Table 6.1.1 reveals a striking difference between particularly IETF on the one hand side and ITU and ANSI on the other, with ISO placed somewhere in between. This difference, however, is not as unexpected as it may appear at first glance. Until as recently as 1988, CCITT (International Telegraph and Telephone Consultative Committee, the predecessor of ITU-T) was basically a closed community, made up largely from PTTs and equivalent national organisations. Representatives from other organisations or institutions (vendors, users, research and academia), termed 'Scientific and Industrial Organisations' (SIOs) in ITU have been allowed to participate as experts, but still have no voting rights. At the same time, the monopoly positions of the national PTTS had led to well-established relationships with the respective major domestic vendors. Consequently, the environment within which standards setting took place could be described as 'static', to say the least (see also

[108] It must be noted that the numerical figures presented in this table, and in the subsequent ones in this section, are based on a comparably small number of interviews, and require careful interpretation.

[Gensch 95]). Against this background, the high percentage of long-standing ITU committee members does not come as a surprise.

Things look slightly different as far as ANSI's JTC1-TAG is concerned. This TAG is less a technical work group, but a committee primarily in charge of strategic decisions related to the US involvement in JTC1.

"The JTC 1 TAG serves as the U.S. position formulation body for policy, administrative, organizational, work program, and management matters relating to JTC 1." [ANSI 96a].

Accordingly, this group is made up from representatives who need to be more experienced and more senior than the members of the technical groups. Both these attributes take time to acquire. Thus, it is again little wonder that the single members of the TAG have been active in the standardisation area for a considerable length of time.

At the opposite extreme, the IETF is a very young organisation by comparison, established to address Internet-specific technical problems. Accordingly, procedures adopted differ from those of the older 'official' bodies in more than one respect. One of these differences is the non-existence of a formal membership in the IETF, another one is the comparably short life-span of the individual working groups, which typically address only a narrow and well-defined problem. If you add the strong academic roots of the Internet, which resulted in strong academic participation in the WGs, the combination of these facts may well account for the lack of long-standing members (academics tend to change their employer eventually and move on to industry jobs and give up standardisation).

> *"Sofar I think the most dominant ones have come from the research institutes and the universities. That is changeing [....] the persons now active are moving to the companies to earn some money on their knowledge ....."* (committee member, 1996).

A notable exception is the caste of the 'gurus' who have been involved in the Internet from its earliest stages, many of whom now capitalise on their experience by running their own consultancy firms.

Another factor that might assist in helping interpret the responses is the interviewees' respective affiliations. As can be seen from Tables 6.1.2 and 6.1.3, the vast majority of prospective respondents (i.e. the totality of individuals who received a questionnaire) are working for service providers or vendors. In fact, more than two third of this group come from this side, as do almost 60% of the actual respondents. In particular, it turns out that, with the exception of ANSI, where they form the second-strongest group, user companies are strikingly under-represented. Please note again that I do not consider 'government' as a stakeholder in its own right. Much has been written about public involvement in the standardisation process as such (see e.g. [Aden 93], [Brans 95], [Johns 93], [Libi 95], [OECD 91], [OTA 92], [Repu 95], [Weiss 93]). However, at Work Group level, which will be the focus of the following sections, government employees' dominant role is that of a representative of a large user. This is stressed by a typical government employee's remark (see also [Salt 96]):

> *"I was a national representative at international meetings, and represented the U.S. Government (a big user of networks) at domestic meetings. Of course, while chairing meetings I tried to remain impartial."* (committee member, 1995).

	Service providers/ Vendors	Consult's.	Academia Research	Users (Comm.)	Users (Gov.)	Total
ITU	146 (83%)	8 (4.5%)	9 (5%)	3 (2%)	10 (5.5%)	176
ISO	31 (53%)	6 (11%)	10 (17%)	2 (4%)	9 (15%)	58
ANSI	33 (54%)	2 (3%)	2 (3%)	15 (25%)	9 (15%)	61
IETF	32 (55%)	3 (5%)	16 (28%)	1 (2%)	6 (10%)	58
Total	242 (68%)	19 (5%)	37 (11%)	21 (6%)	34 (10%)	353

Table 6.1.2: Affiliations of the Totality of Prospective Respondents
Editors, chairpersons and rapporteurs (ITU, ISO), members (ANSI),
frequent and long-standing participants (IETF)

	Service providers/ Vendors	Consult's	Academia and Research	Users (Comm.)	Users (Gov.)	Total
ITU	19 (76%)	1 (4%)	1 (4%)	0 (0%)	4 (16%)	25
ISO	6 (43%)	0 (0%)	6 (43%)	0 (0%)	2 (14%)	14
ANSI	6 (43%)	0 (0%)	1 (7%)	4 (29%)	3 (21%)	14
IETF	9 (56%)	1 (6%)	3 (19%)	0 (0%)	3 (19%)	16
Total	40 (58%)	2 (3%)	11 (16%)	4 (6%)	12 (17%)	69

Table 6.1.3: Affiliations of the Actual Respondents

The distribution of professional affiliations already suggests who dominates the committees. Yet, WG members might choose to adopt a more altruistic approach and see themselves as impartial champions of a technically sound, usable and useful system or service, regardless of their employers' commercial interests. However, it seems that this would be asking too much.

Asked how they would characterise their role in the standardisation process a relative majority of the respondents (41%) basically said "company representative".

> *"Predominantly company representative (even at the international level), though I represented the USA at international meetings."* (committee member, 1995).

Yet, some actually wear the hat of a 'user representative':

> *"End user representative seeking non-proprietary solutions."* (committee member, 1995).

Most, however, see themselves in varying roles, depending either on the respective group or the actual level (i.e. national/international):

> *"Company representative at the national level, USA National representative at the international level, and AFII Professional Association liaison at the national and international levels."* (committee member, 1995).

> *"Community representative and promoter of technically superior solutions. Later, as chair, I helped guide the IETF community to consensus on solutions."* (committee member, 1996).

Table 6.1.4 summarises the roles respondents assume for their standardisation work ('others' includes for instance responses like *"No idea"*). If several roles were mentioned, only the one perceived as most important has been included. Again considerable variations between the single organisations cam be observed.

	National rep.	Company Rep.	User advocate	'Techie'	Other	Total
ITU	7 (28%)	13 (52%)	2 (8%)	2 (8%)	1 (4%)	25
ISO	3 (21.5%)	3 (21.5%)	2 (14%)	3 (21.5%)	3 (21.5%)	14
ANSI	n/a	10 (72%)	4 (28%)	0	0	14
IETF	1 (6%)	3 (19%)	2 (13%)	9 (56%)	1 (6%)	16
Total	11 (16%)	28 (41%)	10 (15%)	14 (21%)	5 (7%)	69

Table 6.1.4: How Respondents See Themselves

One thing that leaps to the eye is the vast majority of 'techies' in the IETF (i.e. respondents who see themselves as 'promoters of technically superior solutions'). However, this is not at all surprising: the framework within which IETF works, i.e. the narrow scale of the WGs and particularly the requirement for *"A specification from which at least two independent and interoperable implementations from different code bases have been developed, and for which sufficient successful operational experience has been obtained"* [RFC 96a] if a specification is to be promoted to the level of 'Draft Standard', pave the way for a very technology-centric view[109].

A second outcome worth mentioning concerns ANSI. With more than half of the respondents coming from the user side, it is surprising to see that only 28% see themselves as user representatives, with the others acting primarily on behalf of their respective employer. Of course, the distinction between 'user representative' and 'company representative' is somewhat artificial when looking at user companies - after all, being a company rep to some degree implies being a user rep as well. However, it can be concluded that increased user participation does not necessarily strengthen the user position in a committee unless either it is clear that the requirements of the single user companies are sufficiently similar, or that their individual efforts are coordinated.

6.1.2.3 Working Group Members' Perceptions

Any description of the perception of a standardisation process should sensibly start with a look at how activities actually emerge. Please note that this does not refer to the respective regulations relating to the formal start of a standards setting activity as such, but to the question on which basis committee members observe such a new standardisation project being proposed. That is, the standardisation process starts with the formal recognition of an open question by a standards setting body and the subsequent establishment of a work group in charge of addressing this question. Prior to that, however, other interests may well have played a crucial role. For example, a vendor wishing to have a piece of proprietary technology being standardised may have been instrumental in the establishment of the WG.

Pro-active vs Reactive Standardisation

Whilst these terms seem to be intuitively clear, they may need some further elaboration and explanation. 'Reactive' refers to the fact that standardisation draws upon

[109] There is, however, a possibility that this self-assessment has been somewhat influenced by the very articulate objective of the IETF to produce technically superior solutions. Yet, such considerations are outside the scope of this thesis.

something that is already available. Yet, there are different alternatives what exactly establishes the basis for a reactive standardisation project. For example, in the 'purest' case of reactivity, an activity may be based on an already existing product or service, for which the vendor seeks the consecration of standardisation. One such example is the Ethernet, which existed as a product before standardisation started. In another, more open alternative some entity (a company, a research lab) tries to push an idea through the process, which may not yet have reached the maturity level required for leading to a product. Frame relay is an example of this variant. Finally, the need to resolve incompatibility issues between existing systems may also be a starting point for a standardisation activity. This is a borderline case, very much verging on pro-active standardisation, with X.400 being a good example.

In contrast to the above, anticipatory standards emerge either based on an identified demand for which no products or services exist that meet the requirements. Again, X.400 can be taken as an example, as can be ATM[110] to some extent. X.400, for instance, emerged from the very real need to overcome communication barriers established by various incompatible, proprietary systems. Alternatively, there are the truly pro-active standards, which attempt to anticipate future requirements and try to meet them in advance. The X.500 Directory Service, and the OSI[111] initiative are fine examples of this category. Figure 6.1.3 summarises the different expressions.

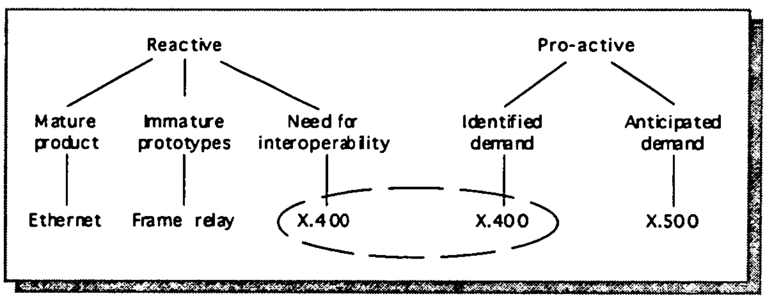

Figure 6.1.3: Different Types of Pro-active and Reactive Standards

It is typically claimed that there has been a shift from reactive standards setting towards a pro-active approach, and that the amount of pro-active standardisation work has been increasing dramatically in recent years, at least in the area of information technology in general and telecommunications in particular (cf. e.g. [Bach 95], [Carg

110 Asynchronous Transfer Mode.

111 Open Systems Interconnection; for the document at the very heart of this initiative, the OSI Reference Model, see [ISO 94a].

89]). This claim is hardly surprising and appears to be very convincing in a fast moving area like this. Yet, committee members' responses give a slightly different impression. For instance, the shift from reactive to pro-active has been confirmed only by a very small group (about 7%) of committee members. According to one interviewee, this shift was initiated by OSI.

> *"Believe this is changing somewhat. For the most part, standards were based on an existing offering that others wanted the opportunity to provide once its value to the marketplace had been demonstrated. When users wanted integrated platforms, they began to demand that their favorite service be available across all the various platforms. This was taking an already available technology and making it standard. When Open Systems came along, standards developers began with concepts that were beyond any single vendor solution. That concept started anticipatory standards development --- trying to determine what customers want before you have product to show and trying to solve 100% of the problem up front through consensus."* (committee member, 1995).

On the other hand, about one third of the respondents stated that activities still typically emerge based on existing products or services (i.e. are reactive). This perception is almost equally valid across all 'traditional' voluntary standardisation bodies looked at (i.e. ANSI, ISO, ITU-T).

> *"Standards typically emerge as de-facto standards created by one company and in one way or another provided to the voluntary standards community to pursue a national or international standard."* (committee member, 1995).

Another category of standards is based on identified - or conceived - user needs.

> *"In my experience it is mostly based on identified demand. For example, the Aviation Industry needed a way of encoding data that minimized the bandwidth requirements, so the Packed Encoding Rules project was born."* (committee member, 1995).

Finally, a large group of respondents (some 30%) observed that pro-active and reactive standardisation exist in parallel. They did not note any particular change over time, but found that whether the process is reactive or anticipatory largely depends on the type of product or service to be standardised, even within IT. For rather more 'traditional' IT components the reactive approach seems to be fairly common; a new mass storage device, for instance, is likely to be based on long established technology. The same holds for e.g. programming languages and character sets. In contrast, technologies like e.g. ATM and the OSI Reference Model typically tend to be based on early lab developments (ATM) or anticipated needs (OSI-RM).

"At times, multiple competing approaches are in the market place that cause incompatibity issues, stds are sought to resolve problems between existing products. (Magnetic tape and radio stds are examples). At other times the lack a standard prevents the industry from moving forward to a higher level of performance, so the industry is waiting for the stardard (X500, EDI/EDIFACT - for electronic commerce are examples)." (committee member, 1995).

As a result of the persisting reactive standardisation, standards committees continue to be a battleground for vendors and providers trying to push their respective ideas and solutions[112]. To summarise this situation in the words of a committee member:

"A product will often give rise to a standards activity but that doesn't mean that the product specification will be adopted as a standard. Sometimes, depending on who originated the specification, it may actually cause other vendors to dig in their heels and oppose such a spec moving towards a standard. Specifications developed by industry consortia have a much better chance of being accepted as stds. On the other hand, standards work may sometimes be initiated as a result of a perceived need even though there may not be any candidate specs waiting in the wings. Standards developing in the latter case are likely to take time to develop as it is often necessary to get agreement on concepts that may be imature or may not be widely agreed in general." (committee member, 1995).

Regarding the latter, the OSI initiative is a case in point. A (perceived?) user need for vendor independent interworking triggered the development of a framework encompassing all communication-related[113] tasks and establishing an 'open'[114] communication platform. It has taken a considerable time span to establish sufficiently mature specifications in the OSI context, a process still far from being complete. With a few notable exceptions, however, OSI products have not been accepted by the market, for various reasons (see e.g. [Hawk 95c], [Wag 95]), in spite of strong backing from various governments (cf. e.g. [Gensch 95], [Bucc 95]). This may lead to the conclusion that timeliness and simplicity are more important for a standards specification to be successful in the market than fully meeting perceived user demands. As one committee member observed:

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112 This is not to say that reactive standardisation should be eliminated, as it remains to be extremely important, for example to end a period of confusion about the future prospects of competing technologies.

113 It should be mentioned, however, that OSI deals only with base standards. In particular, no implementation-related aspects are addressed, nor are functional standards or standard profiles.

114 This term identifies a non-proprietary specification, which can freely be implemented by all interested parties. These different implementations will (should) then be able to interoperate.

> *"In recent years it has been clear that anticipatory standards (e.g. OSI) produce much better technical solutions but fail in the marketplace. This seems to be a byproduct of the apparent fact that designing something from the top down is not as good a mechanism for commercial success as getting something simple out quickly and then changing it based on customer demand."* (committee member, 1995).

Judging by these responses it appears to be safe to say that anticipatory standardisation occurs far less frequently than typically claimed. Even worse, one can easily identify several examples of anticipatory standards that did not quite make it in the marketplace. The most notable of these is the OSI suite of protocols and services, most of which eke out a miserable existence in the shade of the ubiquitous Internet.

The current success enjoyed by the Internet - and its protocols[115] - seems to stress this observation. Whilst important other factors are playing major roles in this success story, the contribution of the standardisation process adopted by the IETF (see sect. 4.1.1), where the scope of a work group is comparably narrow, and thus the overall standards setting activities very flexible, should not be underestimated. Regarding for instance the establishment of a standards setting activity, the IETF process works as follows (according to a WG member):

> *"... Someone (or several people) identify an area that they believe needs an Internet standard. They propose a BOF to the relevant IETF area director. If the people (self-selected) who show up at the BOF decide there is enough interest to pursue the activity, someone is nominated to write-up a working group proposal. Upon IESG approval, the WG convenes. ...."* (WG member, 1996).

Of course, this informal approach does not guarantee success. Yet, if it happens frequently, and if the respective initiators are sufficiently knowledgeable, experienced and enthusiastic, some useful initiatives will result. On the other hand, this makes it also easy for vendors to bring in their own specifications, representing their proprietary interests and preferences.

Influential Factors

It is also worthwhile to have a closer look at what members feel about who dominates the respective committees, and which factors are considered as being most influential when it comes to actual decision making.

[115] Including especially TCP/IP; Transmission Control Protocol / Internet Protocol, which are the core of the whole Internet protocol suite, but also e.g. SMTP (Simple Mail Transfer Protocol) and HTTP (Hypertext Transfer Protocol).

Perceptions mostly reflect the affiliations of the committees' senior members as outlined above. That is, committees are indeed seen as being dominated by representatives of vendors and service providers. Yet, two notable exceptions can be identified: first, the perceived influence of government within ITU bears no relation to the actual number of government employees, which was about 5% among the interviewees (and only slightly higher for all senior committee members). This perception may partly be a relic from the past, when the ITU was pretty much a playground for national PTTs and administrations [Gensch 94]. In any case, at least in terms of numbers government representatives do not play a major role any more. It should be noted, though, that the upper levels of ITU are still dominated exclusively by PTTs and equivalent organisations, which continue to be the only ones with a right to vote in ITU. However, the ongoing process of deregulation is changing the environment they are operating in, as well as their positions within this environment. Accordingly, PTTs will act rather more like service providers in the future, rather than national representatives. Some of the responses confirm this likely trend:

> *"Before, PTTs and/or governments were represented, but now it is changing. At moment the most dominent bodies are manufacturers and service providers."* (committee member, 1996).

Second, about one out of three respondents from ISO observed that it is individuals that are most powerful. As one committee member put it:

> *"Oddly enough, it's been my experience that _individuals_ dominate ISO. Sometimes the individual will have a powerful multinational corporation or government/national interest on their side, but the bully pulpit is controlled by individuals, and only those with a strong sense of purpose survive."* (committee member, 1995).

This may be attributed to the fact that ISO WG members are less inclined to act in a particular role (officially they act in a personal capacity). Within ANSI and ITU a huge majority of members see themselves as representing company and/or national interests. Thus, their tasks are much more pre-defined by company/national strategies and leave less room to move. Much in line with this observation, respondents (again from ANSI, ISO and ITU) stress that speaking out at meetings for or against a proposal is the most important single factor influencing technical decisions. That is, even good proposals will hardly be considered if nobody is available to explain or defend them at meetings (and vice versa).

> *"For any given technical decision the presence of supporters/opponents weighs heavily, for in practice unless there is someone or some organization that champions a solution and pushes it forward it does not get as much*

consideration/exposure as alternate solutions. That is, group members typically do not delve into researching solutions that someone happened to send us unless such solution at first glance seems to be overwhelmingly good. More likely the members push the solutions that they already understand." (committee member, 1995).

The other two factors identified as influencing decisions are a proposal's technical merits and underlying company interests, both of which were attributed with roughly the same - though considerably less - importance.

"*The technical viability of a decision does carry great weight. As almost all members at the technical committee meeting level are engineers, the technical prowess of the solution, tied with the credibility (knowledge) of the person presenting it are very influential. On occasion, a company which already has a product back in their labs will also prove to be a formidible opponent.*" (committee member, 1995).

These priorities are particularly disastrous for user companies. If their representatives were to work successfully in standardisation or if they even attempted to push a proposal of their own they would not only have to attend all meetings, but to establish a reputation as a knowledgeable person (which will cause extra problems given the widespread view 'user = technically unsophisticated'). Gaining this reputation takes time, a fact which collides with most users' quests for quick solutions. Worse, few, if any, user companies will have a sufficiently large interest in standards issues to send people to committee meetings over any longer period of time. The resulting financial burden would be considerable, and especially in times of recession extremely few users will endeavour such undertakings.

Things look completely different for the IETF. Here, the technical merit of a proposal is said to be the single factor of overwhelming importance. In fact, according to the respondents this is almost the only consideration carrying weight during decision making. An exemplary response from a work group member:

"*Technical merits, clarity of presentation, willingness to do the specification writing, willingness to implement spec, immediate utility of spec, interest by vendors and users. Yes, personality, etc. have some effect, but not dominant.*" (WG member, 1995).

Yet, the above comment also reflects another characteristic of the IETF process. That is, it very much depends on individuals being prepared to do the actual specification and implementation work. Much of this work will require support of the respective employers. It may therefore be concluded that these individuals are far more likely to be employed by either vendors or service providers, or academia. The former may hope to push their own proposals within the work groups, to be aware of the latest developments and to capitalise on the gained knowledge and experience. The latter have traditionally been closely associated with the Internet, and will normally find it comparably easy to justify standardisation activities. Users, on the other hand, will need to have a very strong business interest before actually being prepared to pay for working time spent to specify standards.

In this context the IETF's requirement for two independent interoperating implementations required for a proposal to progress on the standards track is of major importance as well. Again, to some degree this does not exactly push user participation as they are far more unlikely to devote time and resources to a pilot implementation of a protocol than are, say, universities or vendors.

Opinions of work group members are almost equally split about whether or not it is necessary to attend the four-monthly IETF meetings in order to push a proposal. It may be concluded that this is less important than it is in the technical committees of the other bodies, but still far from being unnecessary. It may suffice if someone is there to support an idea, who may not necessarily be the original champion.

General Perception of the Processes

Asked to characterise the respective standardisation processes they have been involved in and know of, opinions of committee members form the 'official' bodies (ISO, ITU, ANSI) differ widely; there is virtual unanimity among IETF working group members. Most respondents from ISO, ITU and ANSI expressed a rather balanced view of the respective processes; acknowledging that consensus is important, that the lengthy processes, though laborious and sometimes frustrating, are required to reduce the risk of faulty specifications, to actually achieve consensus and guarantee fairness and openness of the process and thus ensure the widest possible acceptance of the standard, taking into account all views.

> *"In general, I would characterize the formal standards process as open to all interested/affected parties that produces generally stable standards which are moderately successful in the marketplace (i.e., get built into real products that people buy)."* (committee member, 1995).

Yet, they also noted that at times the process is far too lengthy and too formal, and that these attributes may - and sometimes do - thwart a standard's take-off in the market.

> *"Formal, bureaucratic, thorough, pain-staking, arduous, satisfying, useful and necessary, slow-moving, evolving, subject to national interests, dependent on few dedicated individuals in each area of standardization, consensus process is both frustrating and satisfying, rewarding, and economically troubled."* (committee member, 1995).

'High-quality' and 'stability' are the most important positive characteristics attributed to the standards produced by voluntary, consensus-based processes.

> *"Formal processes that produce high quality standards documents which represent a high degree of consensus among the National Body participants."* (committee member, 1995).

Very few interviewees expressed enthusiastic or unambiguous views, neither positive nor negative. A majority of those who did, though, were negative. One such example:

> *"It has become obsolete being far too slow and tedious. The work is characterised too much by "reinventing the wheel" tendencies. The standardization procedure should be a modular one composed of functional reusable blocks and elements. The 3-stage format for an ITU-T standard need to revised completely using a modular architecture. Furthermore, the interchange of information between the various Study Groups through Liason Statements is far slow. Electronic means like e-mail should be deployed. Also the exchange of information between various de-facto standardization bodies like DAVIC, ATM-Forum, MMCF etc. needs to be enhanced."* (committee member, 1995).

However, such an extremely negative opinion was the exception rather than the rule (although there is some truth in it). Most respondents were rather neutral in characterising their respective body's process. Despite this generally observable attempt to be fair and unbiased, however, the overall impression resulting from the responses is a negative one. Respondents clearly notice the weaknesses of the processes they are involved in, and that there is very little they can do about it.

As far as perception of the process adopted by the IETF is concerned, respondents particularly stress the fact that in their views this process is far superior to the 'traditional' ones adopted by ISO, ITU, or ANSI.

> *"The IETF has the smallest and most sensibly designed process of any of the standards bodies active at present, and because of this it is lightyears ahead of any of the other standards groups. (I have also participated in ANSI and ISO standards work as well as in the EMA (Electronic Mail Association), so I have a reasonable basis for comparison)."* (work group member, 1996).

In fact, as will be discussed in sect. 5.3, some elements of the IETF process do represent steps in the right direction, but it is still far from being ideal.

Comments on the strengths and weaknesses of the respective processes largely come down to one prevailing observation. That is, ironically - they are the same. The processes' paramount strength - i.e. being taken serious by its participants; leading to reasonably mature and stable recommendations, accepted by a broad constituency; being open and observing due process - at the same time represents the major weakness, in that it leads to specifications that may have missed the window of opportunity, have been overtaken by the technical development and/or the market (i.e. de-facto industry 'standards').

> *"Its major strength -- its inherent fairness -- is also its major weakness. To insure fairness, ISO/ITU imposes formality and process. But formality and process impose overhead. The amount of process makes things slow."* (committee member, 1995).

There is little one can do about this dilemma between 'stable specification' and 'timeliness'. Measures such as those suggested in the above quote would help, but this is rather more fiddling about with the symptoms than actually curing the disease. Moreover, it has been discussed in sect. 2.1.1.4 that development of a base standard is only part of the overall standard life cycle, and not necessarily the largest part of it.

Being open to everyone is seen as another major strength of the voluntary consensus process. This holds at least for the Work Group level considered here, albeit with one reservation: you have to be able to afford it. Apart from that, virtually everyone can participate at the technical level (with the ITU being somewhat more selective than ISO), and all ideas will receive consideration.

Again, respondents from IETF WGs were in agreement particularly on the perceived strengths of their process. Many responses exhibit a considerable degree of what can be viewed as either enthusiasm or, indeed, naivety. Most consider the requirement for independent and interoperable specifications as the strongest point of the process, thus once more highlighting the technology-centric view already noted earlier as being characteristic for the IETF. The comparably small formal overhead and the resulting speedy process are also seen as major strengths, as is the openness of the process - *"everyone can speak"* -. Yet, not unlike the comments from members of the other bodies, this is also associated with a weakness by quite a few. "Naysayers" and "loudmouths" stand a good chance of delaying and possibly even obstructing the work; the process does not foresee any mechanisms for how to deal with such individuals. On a similar line, the process tends to split complex problems into small, easily comprehensible pieces, thus running the risk of losing the big picture.

> *"IETF is very weak in operational deployment of services. A number of proposals just don't scale in todays Internet. IETF is weak in solving big complex problems. These are split in smaller manageable pieces and solved, but the context of the bigger picture is often lost."* (work group member, 1996).

Finally, the dependence on a sufficiently high number of people prepared to do the work, and capable of actually doing it, is seen as another potential problem.

> *"Strengths: focus on implementation, openness to anyone, attempts to stress technology over politics, minimal BS, strong academic representation. Weaknesses: not able to move fast enough, openness to anyone, politics are intruding, no good strategy to deal with industry as opposed to ietf leading thingsm, hard to find good people to lead things (chairs, iesg, iab)."* (work group member, 1996).

Potential Improvements

Inadequate mechanisms for distribution of, and access to the final specifications are considered by many to be a major barrier to the success of international standards issued by ITU and ISO. With the exception of a brief period in the early nineties, during which most ITU recommendations were freely available via the Internet, these documents could (and still can) only be purchased at a considerable price. ISO standards have always been rather expensive, too expensive in fact to make them readily available to many who might wish to implement them. Draft specifications are virtually inaccessible for the interested public. This is particularly crucial when contrasted with the IETF approach of making all specifications, including preliminary ones, publicly available for free.

> *"Reduce the cost of stnadards, at the limit in distributing them 'freely' on the Internet (WWW or FTP). This is a great debate these days. ISO sees a revenu problem associated with copyright violation."* (committee member, 1995).

Along the same line, respondents were also in agreement that use of readily available technology, especially electronic communication tools, would serve to speed things up. Today, for instance, hundreds and hundreds of pages are still being produced, photocopied and distributed prior to each meeting. Surprisingly, although these committees are producing telecommunication standards, internal use of e-mail seems to be the exception rather than the norm, and even where committee distribution lists exist they are not necessarily used for technical discussions between meetings. It does not really come as a surprise that committee members would love to have electronic means at hand for discussion and distribution of documents. Some respondents also suggested that electronic discussions would help to broaden participation.

> *"Better use of Internet, web pages, ftp sites, electronic mail, on-line discussion groups, and perhaps even video-teleconferencing. Less use of paper."* (committee member, 1995).

Slowness of the process was identified as another major obstacle. Suggestions like *"start with complete proposals"* (like e.g. the 'Public Available Specifications' upon which ISO JTC1 may base its output, see sect. 4.1.1) and *"more work done by the editors prior to the meeting"* aim at accelerating the process while at the same time attempting to retain high-quality output.

Whilst better use of technology would certainly contribute to faster publication of standards, and yield a higher degree of acceptance, more important reasons for the process's slowness are seen elsewhere by many. They consider other, more strategic issues to be of major importance in the long term. For instance, it appears that cooperation between different committees, even within the same organisation, is far from being satisfactory, potentially resulting in duplicated efforts and maybe even contradicting specifications. Accordingly, improving the internal organisation and coordination would also contribute to more efficient and faster work. The same holds for inter-organisational coordination, e.g. for cooperation with the regional bodies like ETSI and with industry fora.

> *"... Simplifying the structure of the overall organization. Making the structure of the groups more logical so that redundancy is avoided and charters are more clear. Enhancing communication between groups by allowing more rapid and less formal mechanisms to communicate. And, speeding up the standardization process by means such as allowing rapid standardization for groups willing to do the extra work to make things happen quickly. I think this can be done without compromising carefulness by enforcing the checks and balances, but allowing them to happen more quickly."* (committee member, 1996).

Finally, a number or respondents suggested that the whole process of writing technical standards in the field of information technology should be changed. In addition to the above they propose to adopt a more project-like approach, where dedicated experts are being paid to develop standards under rigid project management and to a realistic but tight schedule (pretty much the approach ETSI has adopted). In such projects all stakeholders need to be represented, including especially the user community. In particular, sufficient user requirements are seen as a mandatory prerequisite for any standards setting activity. Subsequent validation of the standards is also considered important. Finally, the strategic importance of standards has to be made very clear to all parties. All in all, a process implementing these suggestions would come very close to the model of an ideal standards setting process introduced earlier.

There are very few improvements suggested from IETF work group members. Most of those suggested problems that would need to be addressed are related to scaling; with the Internet continuously growing at a rapid pace, this is becoming a major issue. This includes the need for more volunteers, rules how to decide when 'rough consensus' is reached, as well as mechanisms how to address more complex problems. Yet, no solutions, nor even realistic suggestions have been presented.

> *"I think its gotten to be very difficult to find qualified WG chairs and Area Directors. These are all volunteer activities, and the demands (esp. for ADs) can be enormous. And especially when the growing Internet constituency can lead to more conflicting opinions than used to be present.*
> *So this is a serious problem, but I'm not sure what to do about it. The self-selected volunteer nature of IETF participation is a key strength, but it is a two-edged sword, since a few loud-mouth jerks can really make life miserable for everyone else in the group. But what's the alternative? I can't think of any that don't have even more serious problems."* (committee member, 1996).

However, one recommendation made was at least astonishing, as it represents a clear contradiction to the valued openness of the IETF process. This respondent stated that it would be necessary to introduce

> *"Core groups and specific listings. There is too much dead wood on the mailing list and so on."* (committee members, 1996).

If this became reality, the IETF would be more elitist than any of the other bodies.

6.2 User Participation in IT-Standardisation

This section outlines and discusses the views related to user participation in the standards setting process, as expressed by some of the stakeholders associated with that process.

For the purpose of the discussion at hand the major stakeholders include user companies, the standardisation bodies themselves and, last not least, the individual committee members. Their respective views and opinions on (increased) user participation in the standards setting process and related problems have primarily been compiled through interviews and questionnaires, but also are drawn from official publication (particularly for the different standards organisations). The focus, however, will be very much on users and committee members.

As could be expected stakeholders' opinions differ widely. An initial guess would be that the 'official' point of view calls for stronger participation of user representatives. In an increasingly competitive standardisation environment the idea would be that user participation can help raise a specification's chance of survival in the market place. It is - or at least one would want to think it is - in every standards setting organisation's interest to produce specifications that meet the demands and requirements of their prospective users, and thus stand a chance to be actually employed as a basis of products or services.

On the other hand, one could imagine that work group members will hardly be pleased by the idea of an increasing number of participants. To make matters worse, these new members may be expected to be not as technically sophisticated as standardisation 'professionals' might deem necessary. Accordingly, one could anticipate major reservations against a larger number of user representative on the committees. Yet, assuming that single committee members also like to see the specifications they are producing being turned into products, one might also expect that user participation is considered useful if restricted to requirements collection and reviewing, as opposed to fiddling about with the more technical aspects.

Looking at the issue from yet another angle, one could expect users themselves to be quite ambivalent in their views. Leading edge users, strategically employing state-of-the-art technology to support advanced applications and organisational structures are likely to have clear requirements for additions to existing services, or altogether new ones. They may therefore decide to carry these requirements into the standards setting process. To have at least a realistic chance of success, however, their efforts should be backed by sufficient resources. That is to say, if leading edge users at the same time happen to be sufficiently large (i.e. Boeing, General Motors, British Airways, Reuters and the like) they may well be in a position to be successful in pushing their requirements through.

In contrast to that, one would expect that less sophisticated, and less prosperous organisations without far-reaching requirements will tend to consider involvement in standardisation being just not worth the effort. They will either try to get by on what they have got, to talk to their service providers and/or vendors in order to get 'customised' solutions (with all the risks and problems associated with this approach), or to solve the problems internally by integrating 'home-made' enhancements (with largely the same problems as customised solutions). Moreover, to actively get involved in the standards setting process will probably be regarded as being far too expensive and time consuming for SMEs[116], especially in times of recession. What's more, the eventual outcome of such involvement lies too far in the future, and is far too uncertain, as to be of any perceived real benefit.

So much for some initial deliberations. Subsequently, I will describe and discuss the opinions and ideas on these issues, as voiced by committee members and user representatives. The focus will be on two aspects I consider crucial: ways to integrate user requirements into the process, and what should - and can - be done about the small number of users on the committees.

6.2.1 The Committee Members' Views

The idea of increased user influence has advocates amongst the respondents, yet is far from being uncontroversial. A considerable number of cons and reservations have been voiced by committee members, which is basically what could have been expected (see above). However, there have also been outspoken supporters of more user input to the committee work. In fact, and maybe somewhat surprisingly, these supporters form the majority. Still, a significant degree of reluctance to let user representatives have a greater say in the process is apparent as well. Finally, a third group was in support of increased user participation under certain conditions, or within only limited areas where these respondents felt users could contribute. These three different lines of thought will be presented and discussed in more detail in sect. 6.2.1.2. Prior to that, however, I will have closer look at how user requirements are actually fed into the process, from where they typically originate, and what committee members feel could be done to improve the current situation, if anything at all.

6.2.1.1 Integrating User Requirements!?

The formal procedures which have been established by the 'official' standards setting bodies (see sect. 4.1) give the impression that well-defined user requirements are essential. Indeed, it seems that without adequate requirements from the user side no activities are initiated at all. This ideal situation has already been corrected during the

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discussion on the relations between the different stakeholders (see sect. 6.1.2.1). Still the question remains whether the procedures are adhered to during an activity, and particularly how the reality in the work groups and committees looks like with respect to 'integrating user requirements'.

Both formal and informal cooperation has been acknowledged by the respondents from ITU, ISO and ANSI. Typically, formal cooperation is on a liaison basis, that is, the user group participates in meetings and receives the written output, but has no right to vote. There is also informal cooperation through personal contacts, or through organisational delegates wearing the additional hat of a user group representative.

> *"Relevant user groups are granted liaison status with committees; in some cases the liaison is 'formal', meaning that paper is transferred, in other cases a representative of the user group attends meetings regularly."* (committee member, 1994).

Yet, it seems that cooperation is at the discretion of the respective committee, and that it is very much by chance if cooperation in whatever form occurs at all.

Given the informality of the IETF process, it is hard to identify any cooperation that goes beyond 'whoever shows', i.e. there are no dedicated user-representatives, but delegates from user companies or organisations participate in the WGs just like everyone else.

> *"People who are members of the IETF are members of the IETF, not members of some user group."* (committee member, 1996).

This may be an overly naive view; some WG members do see themselves as representing certain constituencies. Still, the fact remains that so far no distinction is being made by members of IETF WGs between the different affiliation backgrounds participants come from. Users, like vendors, providers, and other groups are supposed to work for the benefit of the Internet.

Yet, one respondent (representing a vendor) noted that real user requirements do make it into the IETF process, via representatives from service providers or vendors.

> *"This is usually done by proxy through vendor representatives. In our case, we participate in the IETF process with the requirements of our user base very close. We have to build products that appeal to our users, so we very actively solicit input from the user community. We then represent that position during the standardization process."* (committee members, 1996).

This sounds reasonable, and if all providers and vendors behaved that way, it might well be a solution to the problem how to represent users in standardisation.

Another approach, adopted and eventually cancelled by ISO JTC1/SC18, and, more recently by ITU-T as well, is to employ a 'user requirements' WG (the term 'service definition group' was used by ITU).

> *"SC18 made a big show of developing user requirements; it even had a whole working group devoted to the process. I think the effort largely failed because (1) nobody could agree on what a user was, (2) the other WGs tended to look at WG1 (the user requirements group) as an impediment, and (3) when budgets got tight, nobody could afford to send real users to meetings just to oversee a process."* (committee member, 1994).

However, it looks very much as if this approach was a failure in the eyes of many committee members - if they happen to know about such groups at all. Whilst overall the comments range from "*... invaluable to the standardisation process ...*" to "*... at best as not necessary and at worse a hindrance ...*", most interviewees from both organisations conceded that they really had no idea what the respective group did, or that they did not have sufficient experience (if any) with their work to comment on it.

A popular perception on dedicated user requirements groups held by a number of respondents can be summarised as follows:

> *"Unlikely to be valid representatives and often negatively regarded by those who believe they do the 'real work'."* (committee member, 1995).

This seems to be a major issue here. If a 'user requirements' group were established, they would have a major credibility problem with two different facets: first, the group would need to prove that it actually is a representative of the whole user community, and not just representing, for instance, some very large specialist users or users of specific products only. Second, it would be an uphill struggle to convince members of the technical groups that they did valuable work and contribute significantly to the overall process. Especially the latter, rather more psychological problem is almost impossible to overcome in the short term (if at all). Given the fact that these groups have been disbanded by both, ITU-T and ISO, it would seem that these are indeed serious problems.

For the following considerations it may be worthwhile to make a distinction between the ITU SGs and ISO/IEC JTC1, and ANSI JTC1 TAG, and the IETF. Both the ITU and ISO committees are technical work groups, which are effectively at the bottom of the whole formal standardisation process, in charge of doing the actual technical specification work. The TAG is ANSI's 'Technical Advisory Group' to JTC1, i.e. rather more a management group than a technical one. Being somewhat removed from the technical process their perception of how user requirements are integrated into the technical work may be expected to differ from views expressed by members of these technical groups, who have to face those problems as part of the normal standardisation work, and to reflect much more the 'how it should be' than how it actually is. Finally, with the smaller degree of formalism characteristic for the IETF, little distinctions may be expected between users and representatives from other constituencies (see above).

In spite of the well defined formal user requirements procedures in place, reality looks slightly different:

> *"There is a formal mechanism, prior to the development of a standardization project. Sometimes, however, the list of requirements is prepared after the work on a project has started."* (committee member, 1994).

Indeed, from the responses by ISO and ITU members it can be concluded that users only play a minor role in the compilation and formulation of what is taken as their requirements. A very pointed statement as to who identifies the initial user requirements comes from a particularly long-standing committee member, who remarked that this would be:

> *"Whoever has the money to push it in ITU or ISO. It is never the users."* (committee member, 1995).

To be more precise, it are largely the technical people who specify user requirements. This holds despite the official procedures in place.

> *"For pro-active standards development, the user requirements are most often generated by the technical people currently participating on the standards committee, based on their knowledge of their own organization's requirements. ....."* (committee member, 1994).

Whilst this assessment is shared by more than 70% of the respondents from ITU and ISO, it reveals a fairly common, yet potentially disastrous situation. It is well known - e.g. from the usability literature - that what designers think users want is not necessarily what users actually need (see e.g. [Lind 94a], [Niels 93]).

Another aspect worth mentioning is that the term 'user requirement', or rather 'user', is not always taken too seriously.

> *"Usually, user requirements need to be identified before standardisation work can begin. However, the term *user* is often not taken very serious, e.g., any person is a user in the end, i.e., anybody can take the role of a user when user requirements need to be established."* (committee member, 1994).

As one consequence,

> *"There is, unfortunately, a problem in determining REAL user requirements. Doing this scientifically would take billions; generally, the representative experts are trusted. If, however, an expert wants to influence a standard, they can try to insert a 'bogus' requirement that would help lead toward a particular design."* (committee member, 1995).

This strategy is well suited to jeopardise any attempt to compile, and follow, real user requirements[117]. Even worse, participation of 'real' users (i.e. representatives of user companies or user associations acting on behalf of their members) will be of little use if it is that easy to push requirements of whatever origin. To make user involvement in the process meaningful some mechanism would be required to determine who actually represents the users' side.

Despite the different scope of the ANSI JTC1 TAG there are no differences to ISO and ITU with respect to the initial integration of user requirements into the process. ANSI members too concede that initial requirements are primarily established by technical people, without any prior formal requirements definition process.

> *"Initial requirements can either be from a company sponsor (often based upon a technology they are developing) or from the committee itself who recognize a technical area they feel is in need of standardization."* (committee member, 1995).

The difference supposed earlier surfaces when looking at mechanisms for integrating requirements during the standardisation process. Whilst potentially damaging effects of the current practice have been stressed especially by ISO committee members, most ANSI members emphasised that there is ample opportunity to have requirements considered during the process:

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[117] I remember a meeting of SC18 WG 4 I attended where representatives of a major PTT easily managed to start a lengthy discussion on a particular detail of the X.400 specifications simply by claiming that this was a user requirement. They were not asked to substantiate this claim.

> *"User requirements can be integrated at any point in the process from the creation to the final vote. Public Press Releases are placed in the public record describing the start of a project, or the vote in the search for consensus. Every public comment or concern must be responded to in writing by the appropriate committee before the project can reach it's final state as an approved national, or international standard."* (committee member, 1995).

Whilst this is true in theory, from comments made by other members one could suspect that these procedures resemble a paper tiger, in that they have so far failed to generate significant input.

> *"No* [mechanisms to integrate user requirements either prior to or during the standardization process] *on the part of the standards organizations themselves. In fact there was a recent proposal to attempt to get user organizations more involved in the standards development process which was defeated. Basicly the attitude was that if users wanted to be involved, they should join the relevant committees and participate in the process. (This of course conveniently ignores the fact that most users could not afford anything of the sort.)"* (committee member, 1995).

At the same time, they stress that vendors and service providers have a strong incentive to listen to their customers' needs, and thus to introduce these requirements into the process. It remains to be proven that this assumption is actually valid.

Another difference to the technical committees is revealed in another comment made by a TAG member.

> *"What I think I see is a proposal either at the JTC1 level or the TAG level to initiate an activity in a particular area, which is then voted on and if accepted a working group is set up. I strongly suspect there's a fair amount of behind the scenes politicing before such a proposal is made or a vote taken (in fact I know there is)."* (committee member, 1995).

This "amount of politicing" can be attributed to the fact that the TAG is in charge of more strategic decisions - as e.g. proposing a new standards initiative - the form and outcome of which may well effect company strategies far more than the 'simple' technical decisions taken elsewhere.

As could be expected, responses from members of IETF WGs tell a story slightly, though not too, different from those of the other bodies. In general, the responses indicate that it is of little importance for WG members where the requirements underlying a standards setting activity come from, and whether or not they are real. Whereas a number of respondents note that requirements are made up by technical people, the overall view seems to be 'who cares'.

> *"By the time IETF WG's (usually) get to see a proposal, where the requirements came form isn't always clear. It is comparatively rare (thogh not unheard of) for a requirements spec to actually originate in the IETF itself. Given that they originate outside, whether they come from users (or marketeers perceptions of users' needs), or technical people, or ... is hard to determine (and rarely relevant)."* (WG member, 1996).

This is not really surprising given the underlying IETF approach that people in the work groups act as individuals rather than representatives of a company or some other constituency. As stated in [RFC 94d], the 'Tao of the IETF',

"The IETF is the volunteers who meet three times a year to fulfill the IETF mission. ... There is no membership in the IETF."

A WG member puts it a little stronger:

> *"Organizations are not represented at all. The IETF is a group of individuals, not representatives. People who think otherwise are in need of (and end up getting) a course correction. The closest the individuals in the IETF come to organizational representation is when they talk about a particular product or body of code they work on and how some action being considered in the IETF will affect it."* (WG member, 1996).

Again this may be overly naive, since some respondents see themselves as representing their respective employer or some other constituency (see sect. 6.1.2.3). In any case, however, the current situation is about to change, caused by the recent commercial success of the Internet, which changed the largely academic Internet into something potentially profitable for vendors and service providers.

> *"Was research institutions (and some government) Now taken over by "routing companies" Cisco and so on. Currently the sw vendors are pushing and dominting my area, most notably netscape and Microsoft."* (committee member, 1996).

If this is actually going to happen the IETF may eventually (have to?) transform itself into an organisation very much akin to ITU.

6.2.1.2 (More) Users on the Committees?

Given the 'official' standards setting bodies publicly expressed opinions on increased user participation in the standardisation process one might wonder if these views are shared by those who would have to live with more users in the committees - i.e. the current WG members. To come to the purely numerical result first: yes, a majority of members would welcome stronger user participation in and, even more so, stronger user orientation of the standardisation work. However, this does not give the whole picture by any means. For one, this view was far from being unanimous. A broad range of reservations have been articulated, as well as a number or pre-requisites that would have to be met if more users were to be welcomed. Moreover, there are significant variations in the responses from members of the different committees.

In simple numerical terms, 46% of the overall respondents were in favour of increased user participation, 33% were against it, both without any reservations. The remaining 21% supported stronger user participation in principle, but would like to see certain limitations regarding the circumstances under which they would welcome more users. These figures underpin the strong ambivalence about (increased) user participation. Three quotes may serve to summarise the different lines of thought. Those in favour typically point out that standards, and products based on these standards, would stand a better chance of being accepted in the market place if standards development were based on real-world requirements rather than on what some people think might be a requirement. To achieve this goal, their prescription is to get more users involved.

> *"Yes, because sometimes we get the impression that experts are alone in their corner and then we start to doubt if they are connected to reality or not. Having users involved as much as industry and governements would mean gretaer consensus, greater balance of requirements and greater applicability."* (committee member, 1994).

In contrast to that, opponents comment that more users would mean more process, reduce the signal to noise ratio in the committees and, typically, that users do not really know want they want.

> *"I am sorry to say the contrary of what is generally expected but I do not believe in the interest of users' opinion, at least in Telecommunications. Users need to transmit the maximum of data to the best price. After that, they do not care if it is IP, X.25 or Frame Relay. Or if they care, it is because it is writen in their newspaper that this technique is the best one! Telecommunication domain is very complex. And most of users have not the time (and it is not their job) to analyse technical things in that matter. I believe that users' needs are best defined by operators people, in the condition that there was a good link, internally to the operator's company, with the client (genreally through sales people)."* (committee member, 1995).

Popular pre-conditions that would have to be met to make user participation meaningful in the eyes of the third group of respondents included 'for requirements review only' or 'depends on what is being worked on':

> *"Greater user participation in generating and reviewing the user requirements would be of significant benefit. User participation in defining*

the details of a system to system interface would be of less benefit. If the standard is for user to system interface, then user participation in the definition would be more useful. A system to system interface requires technical decisions, based on what is technically feasible, and should be driven by those companies which will have to provide the products." (committee member, 1994).

The motivation behind this view is very similar to the one expressed by the first group; user participation is sought not to work on the technical nuts and bolts of the standard but to increase its final credibility and acceptance. An increase in the number of users in the committees is believed to achieve this goal (discussions relating to this issue can be found in section 2.1.3 and in chapter 7).

The overall impression from many of the responses is that to a considerable degree users are seen as inadequately technically knowledgeable. This perception leads to the major concern about an increase in user participation, also expressed by respondents otherwise sympathetic towards the idea of stronger user involvement: the fear that the process would be slowed down even further, thanks to user representatives who would use up major portions of the limited and precious time available at meetings.

"Lack of user experience in developing technical solutions would interfere with the development of standards." (committee member, 1996).

This central theme can be observed across all standards setting bodies. Almost per definition users are considered less knowledgeable in terms of technical bits and pieces than people working in the committees.

"In general, it would not be useful to have users attend standards committees, because users are not knowledgeable about 'engineering' solutions." (committee member, 1996).

Whilst this may be true in some cases, it seems questionable that user representatives per-se do indeed lack technical knowledge and experience. This holds particularly for representatives from large user companies, who more often than not have to struggle with inadequate standards and implementations and have to design their own solutions to get round these problems. For a discussion of inter alia this issue see chapter 2.

Another popular perception of users is that they are sometimes out of touch with reality as far as their wishes and perceived requirements are concerned. They are said to want networks and services to be faster, cheaper, and prettier, but not to be able, or unwilling, to specify what exactly these wishes mean in technical terms, and to recognise if and when their requirements are unrealistic.

> *"End users typically generate comprehensive wish lists without an understanding of the trade-offs that a manufacturer has to make."* (committee member, 1995).

Users are also seen as not necessarily willing to buy what they required in the first place. These two concerns are interrelated. Users may rightly ask for additional functionality to be integrated in developing standards, or maybe even for new additional standards. Yet, if chances are that they will not buy the products based on these standards there will be little, if any, inclination to listen to them.

> *"It is frequently the case that a participant from a user organization may not know the direction that his organization wishes to take; in fact the organization itself may not have a well-formed plan. The classic example is OSI, where the U.S. federal government led the way with GOSIP and induced many companies to spend large amounts of money on both standardization and product development, and then failed to buy the resulting products."* (committee member, 1995).

Despite all reservations, the one major benefit almost unanimously associated with increased user participation in the standards process is 'closer to reality'. That is, with users being more active in (parts of) the process, the final specifications are supposed to be closer to their needs and enjoy broader acceptance in the market place. Thus, there would be a

> *"Better chance of the specification being usable and " what the customer wanted". Better chance of implementation and take up."* (committee member, 1996).

Moreover, standards would be implemented more readily as it could be proved that they meet actual needs and would be bought if and when available. This, in turn, again implies that user input is primarily considered important for acceptance of a standard in the open market rather than technical brilliance.

> *"Apparantly recognized user requirements would encourage rapid and large-scale implementation of the standard. And user participation is a direct way to obtain accurate user requirements."* (committee member, 1995).

How to make users participate in the process is another controversial issue. For example, the idea of user participation through dedicated user groups, representing a broader constituency with a stronger financial basis, enjoys some support. However, this approach might cut both ways, as it would also rise new questions regarding the legitimation of the representatives. Moreover, funding would remain an issue.

> *"What qualifies a user? EVERYONE has some agenda. How do you keep other organizations (vendors, manufacturers) from influencing user groups (or even creating their own)."* (committee representative, 1994).

In any case, respondents were clear that user representatives would need a clear mandate and would be required to work continuously with the respective groups.

> *"Only if the participation is consistent and by the same representative each time. A major problem in standards development is new people coming in to each meeting and re-hashing topics that had been previously discussed. As previously stated, a standard is an agreed upon solution, not necessarily the best solution, and new people coming in to each meeting can usually find a better solution that is not agreeable to all participants."* (committee members, 1994).

An alternative approach proposed by some basically provides for occasional participation of user representatives plus input via e-mail or correspondence. They suggest that funding required for user participation be provided by third parties with an interest in an increase in user participation, prominentely including governments which are supposed to be interested in standards accepted in the open market.

Many interviewees from ANSI, ISO and ITU identified a major obstacle to user participation which has nothing to do with technical sophistication, slower processes or market issues. Rather, it is rooted in a) the - lengthy - current standards setting process as such and b) the current recession. That is to say, funding of standards related activities has become a major problem, predominantly for users, but increasingly for service providers as well.

> *"These costs are increasingly becoming an issue; it is now very difficult to obtain adequate funding and to justify attendance of meetings. The major question asked here is: 'is this part of our core business?'."* (service provider representative, 1995).

Against this background of tight budgets and insufficient understanding on the users' part about the benefits of standardised solutions there are considerable concerns about how to actually increase user participation in the technical committees. A broad variety of suggestions have been made, including the employment of cognitive psychologists to research user requirements and the establishment of special demonstration sessions for user representatives. Yet, a strong majority of respondents (except for the IETF) pointed out that it would be necessary for users to attend meetings and have their voices heard, whilst at the same time stressing their belief that this is an unrealistic solution because of massive funding problems.

"I really don't know; face-to-face participation in the formal standards process is expensive, and even large user groups may not have a budget that can support full-time representation. And while e-mail eases communication bottlenecks, it is still not as effective as an actual meeting for trashing out differences of opinion and building consensus." (committee member, 1994).

In fact, it appears that almost all major problems associated with a stronger user representation in standards committees (except those directly related to the process as such, as e.g. a slower process) inevitably come down to funding: who is going to pay to enable user representatives to attend meetings, and to actively participate in the work of standards setting bodies? All other concerns committee members might have in relation to more user representatives in the meetings are dwarfed by this problem.

One popular suggestion to circumvent the whole problem of user participation, requirements compilation, and meeting real market needs is to shift the whole issue to the market, and let the users demonstrate their influence there.

"Why shouldn't users use the market place to vote their preferences? (If they are good products- buy them -if bad products- don't buy?)" (committee member, 1996).

Similar propositions, stressing the users' hold over the industry through their purchasing power, can be found in the literature (see e.g. [Farr 90], [Ferné 95]). Yet, the weakness in this idea should be fairly obvious: if you have bad standards, even those products fully implementing them would be far from being good. They would be as good as you can get them, but within the limitations established by the standard in the first place. If users want to exercise their influence in a meaningful way, there will be little alternative to contributing to profile development, maybe even to product design and, first and foremost, to standardisation.

As far as the IETF is concerned the virtually unanimous opinion on how users should participate in the process is along the line of "join the lists".

"Go to meetings, join the lists, read the documents, comment them, ask questions on the lists, volunteer to write requirements docs, help testing pilot applications, volunteer to write minutes, ... I'm against user committees. The only way for participations is as mentioned above. No formalities." (committee member, 1996).

This approach has the obvious advantage of eliminating the overhead (in terms of organisational efforts and possibly additional time) that may potentially come with user groups. Moreover, if it is true that the bulk of the standardisation work is done, and the decisions are made, on the respective lists of the single WGs (as opposed to 'during the meetings'), this would be a very convenient platform for users to contribute, saving at least travel-related costs. On the other hand, given the extremely 'techno-centric' nature of the IETF work (see above), this bears the risk that non-technical points raised by users would simply be ignored by the majority of 'techies' in the working groups.

6.2.2 The Users' Views

Whereas most of the committee members interviewed had articulate and clear views regarding the pros, cons, and consequences of user participation in the standards setting process, this does unfortunately not hold the other way round, i.e. for the companies surveyed. In fact, virtually all organisations in the case study that are in one way or another represented in standardisation bodies are either vendors or service providers themselves, or happen to have some interest in a specific, application-oriented area. In particular, none of the user companies (with just one exception) showed any interest in the type of infrastructure-related services to which e-mail and directories clearly belong. This is in line with findings reported in the literature (see e.g. [Alex 95], [Saltz 93]), and will subsequently be discussed in more detail.

In addition to the group of large users surveyed in the case study, three service providers and three vendor companies (all of which are also users) were represented as well. As it turned out, all but one of the latter group have been very active in different standardisation bodies, and consider this activity as being vital to their respective business. A service provider notes that his company either tries to push developments into a certain direction, or just observes what is going on in order to learn as early as possible about upcoming changes. Both forms of participation are considered as being vital for the business.

Another representative of this group commented:

> *"Many of our customers expect and demand that we participate in the standards activities. Participation in the standards process is a required element of our business."* (user representative, 1995).

This particular response seems to hint at a way round the problem of user participation in standardisation. Users might employ their vendors or service providers as 'proxies', and make them act on behalf of their users in the committees, based on compiled requirements and needs. However, none of the other vendors and providers reported similar expectations from their users. Apart from that, and probably more important, the problems to be associated with this approach (prominently including vendor 'lock-in'), still hold.

The focus of this work, however, is on users rather than 'vendor-cum-users'. Three different types of user companies may be identified with respect to participation in standardisation activities:

- **Non participants**
  They form the largest group by far. The reasons for not participating in standardisation typically run along the lines of *"No real benefits"* and *"We are toooooo busy for the most part"*. These arguments, of course, are little else but two wordings for the same perception - that being active in standardisation is not worth the - or indeed any - effort.

- **Selective participants**
  Two (comparably small) companies reported activities in sectors they consider as being vital to their core business. In both cases this has been the area of EDI[118], and in both cases they acted on behalf of their respective constituencies. That is, they did not only represent the companies itself, but larger market segments, similar to e.g. a trade association (although the ties are less formal). In both cases, IT standardisation has been recognised as being critical for the respective business domains, especially as companies in both sectors typically need to communicate with an extremely broad range of business partners and clients, and as EDI standards relate to commercial practice. To enable that sort of communication, systems based on internationally agreed standards need to be in place. Also in both sectors, there is no single influential entity that could lead a standardisation process. Thus, it seems that a sufficiently urgent need for established standards may well push even smaller companies into the standardisation process.
  Another interviewee described his own past activities in standards setting as largely based on *"personal interest plus a supportive director"*. In this case, the company reportedly benefitted from the activities although they had neither resulted from an identified needs, nor had they been part of a corporate strategy.

[118] Electronic Data Interchange.

- **Genuinely interested Participants**

  Only one respondent has been active in different standardisation bodies because of identified corporate needs and requirements. In contrast to the companies discussed above these activities were primarily in more general infrastructure related areas (as opposed to specific, business-critical applications such as EDI). It should be noted, though, that this company is a very large and pro-active user indeed, with a track record in IT standards development. Size and global operations, however, do not seem to be sufficiently strong motivators in their own rights. Other equally large and geographically even more separated users did not show any tendency to become active in this area.

On the whole, the responses suggest even less interest on the users' side to participate in standards setting than could be anticipated from earlier analyses (see e.g. [Jak 96d]). Interviewees typically commented that their companies do not see any business benefits in such activities and are therefore not prepared to spend considerable amounts of money on people travelling to meetings and working on standards committees. It may be concluded from these responses that standardisation is perceived as being too slow and too expensive, with a poor return on investment.

> *"no time, too expensive. hard to justify since it takes too long for benefits to be realized."* (user representative, 1996).

Moreover, it is felt that standardisation does not deliver. If this perception of the results of the 'official' standardisation processes were widely held in the industry it would explain the reluctance on the side of the users to contribute to standardisation. Yet, this view is not really surprising: the lengthy processes that in many cases yield specifications that cannot be directly implemented (hence the need for profiles), and that, if and when implemented, give no guarantee of interoperability.

As could already be expected from the discussion of the relations between the different stakeholders in standards setting (see sect. 6.1.2.1), and especially from the analysis of user requirements (see sect. 5.1), for most users inadequate functionality must be dropped as a potential motivator for participation. A typical example of a list of essential/nice-to-have features looks like this:

> *"Primarily to be able to send attachments, to have immediate mail delivery, and to have remote access from both ISDN and analog phone lines."* (user representative, 1995).

Even if more elaborate requirements were available there would be little inclination to address perceived service inadequacies by seeking to influence standards setting. As many firms in the case study (including really large ones) simply buy their hard- and software off-the-shelf, they would naturally look to service providers and vendors to come up with solutions if problems arise. A typical approach may be summarised as:

> *"organization is not interested in standards issues, since we purchase software from Microsoft or Microsoft compatible. Thus we are happy to let Microsoft set the standard."* (user representative, 1996).

This response hints at a distinct 'not-our-business' attitude, which could be observed for a number of companies. They do not care how their system is installed, and whether or not any standards-based components are employed at all, as long as the provided functionality and connectivity are deemed sufficient. In particular, depending on just one supplier does not seem to be an issue, despite the well-known potential problems inherent to such a 'lock-in' (see e.g. [EPA 94], [Fan 96], [Jord 95]]).

Going even one step further, another very large company has outsourced all of its IT to a third party, including strategic decisions and, particularly, participation in standards setting. With outsourcing being established as a major trend especially in the information technology field (see e.g. [Gurba 96], [Rao 96]) this approach will lead to a new class of stakeholders in the standardisation process, namely the outsourcing companies. Some companies, though, had identified functional shortcomings they felt had to be addressed:

> "[Technical issues are] *too numerous to mention. Big ones are remote access, internetworking over WANs, implementing, deploying, and managing distributed applications on an enterprise scale."* (user representative, 1996).

Even then, they won't look at standards committees, but would try and solve the problems internally.

> "[We] *had to pioneer many internal implementations to offset product shortcomings and lack of interoperability. We are in reality a classic early adopter, but often must build our own innovator level tools."* (same user representative, 1996).

The potential implications inherent to this approach have already been outlined in sect. 2.2. In this particular case, however, it should be noted that the requirements identified to a large extent relate to implementations rather than base standards.

Most of those users who did go to standardisation meetings did so for almost identical reasons, particularly including knowledge gathering:

> "... *especially to gain experience, insight into other solutions, knowledge.*" (user representative, 1995).

It is likely that this motivation will yield committee members that can be best characterised as 'observers' [Spr 95b][119]. Whereas employees' experience, insight and knowledge are invaluable assets for a company in those areas that are in its business interest, they may be considered as less valuable in other areas. It is comprehensible that under these circumstances inclination is low to put time and money into efforts that do not directly contribute to a company's core business. Only two interviewees reported a 'real' motivation on the side of their companies to participate. One of the EDI using companies attended

> "*To make sure that our business are met.*" (user representative, 1995).

This seems to be the one motivation for users to participate. Unless they feel their core business interests are at stake, they will not be prepared to spend the money necessary to actively contribute to standardisation.

For the other company standards committees to a considerable degree appear to serve as a platform for pre-development cooperation with vendors - in addition to the motivations given above. That is to say, this company has shifted the contacts with potential vendors, at least in part, from bilateral talks into the standards setting process. This is indeed a pretty clever approach: if products have to be redesigned to meet their needs anyway, why not shift part of the work into the earliest possible stage of product development - standardisation. Moreover, they kill two birds with one stone by making sure that their requirements are considered from the very beginning, whilst at the same time having the vendors' staff on the committees work towards the company's goals (at least part time).

> "*All of the above* [push superior technical solutions, promote company solutions, represent company requirements, gain experience and knowledge] *as well as information transfer, education, and influence the standards to be able to scale and function in vast environments. We have found that essentially all vendors think too small and tend to come up with silly solutions which break after a few tens of thousands of nodes deploy*

[119] According to [Spr 96b] this group of committee members characterises their main contribution to standardisation as the *"ability to listen attentively and monitor activities to ensure process is going in the right direction."*

them. Without our help they have not shown an ability to develop robust applications which can scale. Also, virtually no vendors come up with products which are actually deployable "as is". It usually takes us two years working with vendors before their "finished" products become robust enough to function in our environment. It takes longer if we haven't been working with them "up front" through their products' alphas and betas releases. Standards are a way to do some of that "up front" work and achieve a greater "level-set" between vendors. Sometimes it also achieves interoperability between vendors products which is one of the primary purposes of the standards exercise." (user representative, 1995).

Yet, only very large and influential users, preferably those with sufficient purchasing power, and a known reputation as being technically sophisticated and not just dreaming things up, will be in a position to pursue this approach. Another potential problem will occur if several such companies, yet with different needs and requirements, follow this approach. In this case, it would only work if the requirements of these firms were sufficiently similar to allow cooperation at this early stage, with the likely result suiting all needs. In any case, the interviewee thinks this approach feasible.

"I wish that there was a way for the Fortune 100 to work together to get vendors to build products which we actually need and which are robust enough for our usages." (same user representative, 1995).

Under the above premises this would undoubtedly lead to products and, assuming continuing cooperation in the committees, standards which were very useful for the big players. Yet, at the same time problems for other, smaller and maybe technically less sophisticated companies would arise, as their specific environments and needs are not necessarily identical with, or even similar to, those of the larger companies (see e.g. [OECD 95a]). Such company size-specific issues, including e.g. scaling (see above) and, especially, implementation related problems, may be of the utmost importance to large companies running and maintaining their own communication infrastructures, but will be of extremely little interest to SMEs.

"If we take the IETF alone, we are frustrated by their lack of interest in practical implementation issues which directly impact the usefulness and viability of such critical standards such as DNS. Most of their standards have serious implementation deficiencies and many of them are simply unusable (e.g., BGP). If we take ISO standards then the situation is much, much, much worse." (same user representative, 1995).

The interviewee continues by blaming the standardisation bodies for ignoring all implementation related elements of a standard. It is conceivable that large companies would like to solve their specific implementation problems alongside the more fundamental problems addressed by a base standard, and doing so might even be a way of bringing in more users. On the other hand, there are several international organisations in charge of specifying functional standards and profiles. If implementation related problems are considered, their committees might be more appropriate places to discuss implementation issues than are those organisations producing base standards, which should not be designed with a particular future application or infrastructure environments in mind.

Be that as may, a standard needs to be put to use, by integrating it into a service or a product (if you are a vendor or a service provider), or by building applications on top of, or around, it (if you are a user).

> [We exploit the knowledge/expertise gained through participation in standardization] *through application design and development."* (user representative, 1996).

Likewise, knowledge and experiences gained through participation in the standards setting process may not necessarily be exploited through new tangible artifacts alone. Rather, committee members are likely to be among the first aware of new directions and developments; indeed a committee may be the very place were a new development originates. This suggests that some users well see a potential competitive advantage in participation, in that they may be able to immediately use the newly gained information to build leading edge applications, in addition to generally increased knowledge and awareness, which may be invaluable, but is hard to quantify.

> *"Hopefully we put it to work to design and deploy for competitive advantage from our IT investment."* (user representative, 1996).

Responses were split about the perceived most effective and convenient way for organisations to participate in standardisation work. Yet, the overall impression given by the responses was one of considerable uncertainty. Those organisations that have been active in standards setting stressed the need to go to meetings (which is very much in line with the comments made by committee members on the most efficient form of participation), several others felt that increased utilisation of electronic communication media, like e-mail, video conferencing or dedicated newsgroups, would be most useful (again in line with committee members). Still others, in fact a relative majority, considered indirect participation through EMA or EEMA as the way to go.

"Work through EEMA/EMA. These organizations allow users to drive the vendor solutions." (user representative, 1995).

In particular, however, nobody suggested a change of the process as such to better accommodate user needs, let alone made suggestions how this could be done. Apparently, this matter had not received too much attention thus far.

6.3 Summary and Analysis

A concise explanation of what exactly constitutes s 'user' is a crucial step in any analysis on user-related issues in standards setting. The distinction between 'direct users' and 'indirect users' of a standard has been introduced, the latter representing an organisation that employs standards based systems or services in a business environment for its own use, and which has no further commercial interest in them[120].

It should be stressed again that this thesis is particularly concerned with large, technically sophisticated users with specific and well-known needs for, and requirements on, communication systems, rather than SMEs. This further differentiation has turned out to be necessary since major differences can be identified between large organisations and SMEs regarding many aspects of adoption and usage of information technology, including some important to this analysis. The former tend to go for systems based on 'official' standards (those produced by ITU and ISO) if and when available (see e.g. [Dank 92]), whereas most of the latter opt for readily available off-the-shelf systems and services (see also e.g. [OECD 95a]), which need to be cheap and easy to install, maintain and use. With respect to e-mail this means that SMEs are most likely to use Internet-based services if there is a sufficiently strong incentive, that is, or proprietary systems if compelled to do so by a major business partner [OECD 95a]. The non-use of services such as X.400 and X.500 by SMEs is largely due to the fact that insufficient knowledge and resources are believed to be available to employ these systems, which are perceived as being extremely complicated to deal with. At least one of the large corporations interviewed share this view with regard to X.500, which is an additional, rather worrying indication that 'official' standards, and consequently the products implementing them, actually fail in adequately addressing the needs of major market segments for simplicity and usability. In fact, this perception, which is quite typical no matter whether or not it is actually justified, may be considered as a major impediment to a more successful uptake of

[120] Other terms used to describe this community include 'consumer user' [Spr 95c], 'end-user' [Naem 95], or 'business user' [Alex 95].

standard-based systems. With SMEs being a large base of potential customers, it exemplifies the urgent need for simpler standards.

However, an analysis of the relations between the different stakeholders in the process (as depicted in Figure 6.1.2) reveals the virtual absence of any direct participation of users. The main way of 'participation' is almost exclusively through a 'filter' of vendors and service providers. This filter, or barrier, between standardisation and users may be supposed to not only absorb at least some of the requirements identified by users, but to also contribute to a common way to overcome functional shortcomings of systems or services. This approach, based on ad-hoc solutions provided by service providers or vendors may(!) well be acceptable if the identified weaknesses are due to inadequate implementations of the standards, and if any enhancements solve the problems in a standard-compliant and backward-compatible way. Otherwise, the newly gained functionality may well cause incompatibilities with other implementations of the same standard, thus creating a situation standards were supposed to help overcome in the first place. In addition, this strategy will easily lead the user into a dependence upon a particular vendor or provider. If this process takes place at different sites and within different companies, affecting several different implementations, the resulting incompatibilities may easily increase significantly, thus effectively undermining the very idea of standardisation.

Moving to a different topic, it is interesting to see that some of the commonly held beliefs about who actually makes the standards are justified. There is indeed an informal caste of long-standing 'professional standard setters' serving as committee chairpersons, liaisons or editors, a vast majority of whom are indeed representing vendors and service providers, as are in fact the majority of all members. Only a very small group of WG members come from user companies, and a similar number actually see themselves as user representatives. A most interesting fact about these groups is that they are not identical. Thus, even if the popular call for more user participation were answered it appears questionable whether this could actually improve the situation, as many committee members from user companies see themselves as representing their employers rather than the user community. It is worthwhile to keep this in mind, as it follows that calls for an unconditional increase in user participation will not necessarily help strengthen the users' cause. From this it may in turn be concluded that actual 'user representation' cannot be achieved through the mere presence, and work, of representatives from user companies. Rather, it must be ensured that either these representatives see themselves as advocates of the user community at large, or that the requirements of the different user companies are sufficiently similar. As it is most unlikely that the latter will hold this possibility may safely be dismissed as unrealistic. Unfortunately, the former appears to be quite unlikely as well as it would require a very altruistic attitude on the side of the sending user company. Taken together these conclusions suggest that the only realistic way to achieve meaningful user representation is through a coordination of the single efforts, for instance through a dedicated user association representing its members' interests (as e.g. EEMA). Otherwise, there is a real danger that increasing the number of 'user representatives' would primarily mean turf wars not only between different vendors and service providers, but also between users.

With the exception of the strong user representation within the ANSI TAG (which is not a technical but a strategic group, and thus not quite at the centre of this study)[121], there are little surprises regarding the composition of the different work groups. Yet, there is a striking difference between the single organisations regarding the respective role the single work group members assume. There is no dominating faction within ISO, whereas strong majorities of representatives within both ITU and ANSI consider themselves as representing their respective companies. In contrast to that, IETF is led by 'techies'. This difference is nicely reflected in the members' comments on those factors they see as being influential in decision making in their respective committees. In the absence of a dominating group it is the individual that in many cases leads a group within ISO; for ITU and ANSI the need for being present at meetings to defend a proposal is seen as being most important, and IETF members put a proposal's technical merits on top of the priority list. In particular, aspects such as 'meeting user requirements' or 'likely to be accepted on the market' were of marginal importance. From that it may be concluded that today the actual make-up of a committee is of little importance when it comes to taking up the user's stance. This, in turn, again stresses the assumption that it will be up to the users themselves to push their requirements in the committees.

To make things even worse, these factors identified as being influential must in fact be considered as a barrier to more significant user participation, especially the important need to continuously work with the committee, to attend the meetings, and to be able to defend the technical merits of a proposal. Users, on the other hand, want to see

[121] However, such strategic committees as well are usually composed of former members of technical committees [Carg 95].

their requirements being addressed. With the absence of a requirements compilation phase in all standardisation processes considered, with user requirements or market needs not being given any priority to speak of in any of the committees, and with those groups that had been in charge of requirements compilation disbanded, users will be less than enthusiastic about active participation in standards setting in its current form at all.

To a considerable degree committees appear to be dominated by seasoned standardisation veterans. From their comments it may be concluded that although they may well see the weaknesses of the respective processes they are involved in (as they see their strengths), most of them have come to terms with the fact that, although quite a few aspects could be improved, they are not in a position to do very much about it. If this is actually the case, there is little hope of changes for the better originating from within the groups. This holds particularly as several interviewees argue that things have improved recently (abandoning the four-years cycle within ITU-T, introduction of the fast-track and PAS procedures within ISO JTC1, for example). Instead, either market influence, or pressure from 'competing' standardisation bodies or industry fora, or top-down initiatives triggered by strategic advisory groups may lead to some change[122].

Another such change - as perceived by many (e.g. [Bach 95], [Carg 89]) - has been the move from reactive to proactive standards setting. One would be tempted to argue that at first glance users should get more out of anticipatory standardisation; whether or not a widely used industry-standard receives the blessings of official standardisation will not make too much of a difference in most cases. In contrast, meaningful anticipatory standards could help keep IT systems simple and manageable. Unfortunately, this is very much a theoretical perspective. As has been pointed out in section 2.2, user requirements to a considerable degree depend on individual local environments. Identification of generally valid requirements is therefore extremely difficult, if at all feasible. Moreover, as environments change over time (e.g. with the advent of new applications or business processes), predicting future requirements is next to impossible. Even worse, with vendors and providers dominating the committees, it may be assumed that these groups also establish (user) needs as they see fit. Whilst these needs might indeed be based on requirements defined by some of their customers, no mechanisms are available to make sure that these are actually

122 The improvements mentioned above resulted from top-down initiatives [Irm 94], [Hill 96])

general requirements and, accordingly, that standards based on these requirements will serve a wider community.

Even proactive standards based on real requirements, and addressing a real market need, are not necessarily a full success. Again, the case of X.400 provides us with a classic example. The widely identified urgent need to interconnect the various proprietary e-mail systems triggered the initial work done within IFIP[123] in the mid to late seventies. Eventually, the task was transferred to the then CCITT (later ITU-T), who published the first X.400 series of recommendations in their Red Book in 1984. When OSI came to a reasonable level of maturity in the mid to late 1980s, the procurement policies of almost all major Western governments prescribed OSI-based systems. One should have expected X.400 to thrive in this extremely favourable environment. It did not. Yet, a closer look reveals a number of issues that stood in the way of X.400's ultimate success in the market place, some of which are directly related to the outcome of the standardisation process. For one, crucial parts of the first version of the specifications were extremely sketchy (as e.g. the encoding of body parts and the security features) or altogether non-existent (as e.g. the message store and interworking with the directory service). It would appear that whatever was available had to be published as a CCITT series of recommendations at the end of the 1980-84 study period, in order to avoid another four year delay[124]. Likewise, X.400 was first published before the presentation layer standard was ready, and was written to sit directly on top of the session layer (this was corrected in the 1988 version, but not without a lot of difficulty [Larm 94]). It may well be assumed that implementations based on these inadequate initial specifications contributed heavily to the less than satisfactory utilisation of X.400 based services[125].

The non-inclusion of a message store in the initial specifications already points to another problem: the ignoring of technical developments that occurred in parallel with the standardisation process. Accordingly, a technical environment was assumed that represented state-of-the-art in the late seventies to early eighties; it was expected that both MTA and UAs would by and large be implemented on e.g. mini computers (i.e. on systems that would run continuously), with dumb terminals as input/output

[123] The International Federation for Information Processing.

[124] This four-year cycle was abandoned only in 1992, see also sect. 4.1.2.

[125] See also the discussion (in sect. 2.1.2) on the potentially disastrous impact inadequate first expressions may have on the success of a technology

devices. Yet, the diffusion of PCs meant that more 'intelligent' end-systems became available which would, however, normally be switched off at the end of a working day.

Along a similar line, the inclusion of the concept of a user agent suggests that X.400 was supposed to be the ubiquitous e-mail system, providing functionality to the desktop. In fact, this is likely to be an important contributor to X.400's problems in the market, as here again technical development overtook standards development - although at a later stage - and LAN-based e-mail systems became the systems of choice for internal communication in virtually all organisations[126]. It must be stressed, though, that this intended ubiquity represented a major departure from the original rationale for X.400's development, which was to serve as an interconnection medium for proprietary systems.

Taken together, these two developments - the diffusion of PCs and LANs in the mid to late eighties - rendered the idea of 'X.400 to the desktop' virtually obsolete. In more general terms, the time span between the start of the standards setting activity (preliminary work started in the mid/late seventies) and the completion of the final documents led to a missed window of opportunity[127]. Other systems (i.e. PCs and LANs) had occupied the major market segment of corporate internal communication systems. Somewhat ironically, this left X.400 with the backbone market for which it had been intended in the first place.

Although the initial specifications failed to provide for several important features (e.g. security and directory interworking) X.400 systems have always been considered as extremely complex and hard to manage. Indeed, X.400 aimed at providing a solution to all e-mail related problems. As all voting members within CCITT committees came from PTTs or equivalent organisations - who at that time still enjoyed a monopoly situation - it may come as no big surprise that they did not follow a more user-friendly, gradual approach, with a first specification evolving along with upcoming new requirements[128]. Rather, they were in position to follow a take it or leave it

[126] The British Ministry for Agriculture, Fishing and Food (MAFF) was one of the very few organisations to actually maintain a native X.400 system in the early/mid nineties.

[127] In particular, many governments had relaxed their procurement procedures; both the CEU and US government agencies are now using non-X.400 systems (most notably the Internet).

[128] Moreover, an above average percentage of ITU committee members' in the survey assumed the role of 'company representative' (see sect. 6.1).

approach, and design a system that clearly reflects PTTs' ways of thought and met their specific needs, as opposed to those of the users[129].

Another issue which has been raised in the literature refers to the fact that OSI failed to provide for a smooth transition from previously used networks; it had been designed without taking into account the characteristics of older networks. That is, any transition required some form of 'jumping' [Hans 98]. In particular, X.400 is allegedly 'installed-base hostile' (see e.g. [Hans 96]). This claim is justified to some extent. X.400 was indeed 'installed-base hostile' in a way, largely due to the fact that it was considered an integral part of the OSI initiative, and accordingly initially required the use of underlying OSI protocols, implementations of which were not readily available in 1984 (and which have never been really popular anyway). In particular, use of the OSI Transport Protocol Class 0 (TP0) on top of X.25 was mandatory for interconnection to the public X.400 network (X.400 over TCP was introduced only at a later stage)[130]. These strict requirements regarding the underlying communication protocols implied that a prospective user company had to install a complete new OSI-based infrastructure if it wanted to employ X.400, a very costly exercise in terms of time and money, not to mention training and other end-user related issues.

On the other hand, the originally envisioned X.400 system, as an enabler of interoperation between proprietary e-mail systems, was certainly not 'installed-base hostile'. Quite the reverse, it was supposed to enable the single heterogeneous elements of this installed base to communicate. Likewise, when the specifications were first published there was no installed base (apart from proprietary systems); in particular, the Internet was little else than a network for (American) research institutions[131]. Moreover, X.400 was designed to take advantage of the widely installed base of X.25 networks, which at that time represented the most widespread packet-switched network infrastructure (at least in Europe).

129 The 'ADMD' field in an O/R address is an obvious example.

130 This not only represented a severe limitation of technical choices, but at the same time contributed considerably to the overall costs of running an X.400 installation, as X.25 was a costly service.

131 According to [Quart 86], the then ARPA-Internet had some 2000 hosts in 1986, interconnected by 56 kbps links.

Eventually, the increasing popularity of the Internet delivered another major blow. It provided services well beyond the functionality of e-mail (as e.g. file transfer, newsgroups and, later, the World Wide Web), many implementations were freely available or came as an integral part of an operating system (as e.g. in the case of Unix), and systems based on these implementations were comparably easy to install and maintain. The exponential growth of the Internet since the mid-nineties was another major incentive to join this bandwagon.

Despite all this, X.400 was very popular with the organisations represented in the survey. This may be attributed to two facts: first, X.400 systems provided the user with clear contractual bindings with a service provider (typically a PTT), which reportedly was a major issue for the vast majority of organisations (particularly in the light of the perception of an 'unsafe' Internet). Second, it must be noted that the survey was conducted primarily in 1995, when the growth of the Internet had only started gaining momentum. Thus, the situation may be different today.

In summary, it may be stated that a very complex, yet still inadequate first specification which additionally imposed stringent technical constraints, in combination with a lengthy standardisation process that allowed other technologies to firmly establish themselves in the market, led to the comparably poor utilisation of X.400.

Indeed, I feel that the combination of these factors was far more important in this respect than the Internet, the popularity of which started growing exponentially only more than ten years after the first X.400 specifications.

Despite the undeniable general need for open, vendor and platform independent communication, standardisation apparently failed to realise that a protocol stack as complex as OSI will be useful only for a handful of large, technically sophisticated organisations (like e.g. Boeing or General Motors). And finally, the process eventually came up with such a broad variety of different service definitions and protocol specifications that rendered the single specifications virtually useless, and created the need for standard profiles in the first place. Accordingly, OSI must be considered a failure in the market place even although it correctly anticipated general initial requirements.

The X.500 directory service is a similar case, yet it differs from major other elements of the OSI suite in that it has so far managed to remain on the agenda. Again, requirements were correctly anticipated when first standardisation efforts started in the mid eighties [ECMA 85]; a global, uniform directory service is high on the priority list of virtually all users (see also sect. 5.1). However, the service design is overly complex. Although products implementing X.500 have been on the market since as early as 1985, although more than thirty different implementations are available today [Apple 96], and although even the Internet has been experiencing a steadily increasing interest in, and growth of, X.500-related activities, the service is still far from being widely utilised on a global basis.

Of course, in addition to the above reasons, the Internet has become increasingly popular since the early nineties, and has in fact marginalised OSI. This is not least due to the fact that the Internet protocol suite is readily available on virtually all major platforms, comes for free in most cases, is comparably easy to handle and does not cause major installation and maintenance problems. The base protocols are simple (newer protocols are becoming increasingly complex, though) and easy to use. These characteristics are particularly important for the huge number of smaller companies, which have little resources and/or inadequate technical knowledge, and which do not run their own network.

The tremendous success of the Internet, especially when compared to OSI, has been considered by many as an indication of the superiority of the underlying standards setting process (see especially e.g. [Rut 94], [Rut 95], [Sol 92]). *"The Internet standards development process is by far the best in the business."* [Rut 95]. At first glance, this view appears to be legitimate. After all, the Internet (together with its predecessor, the ARPA-Net) has been with us for almost thirty years, and has managed to transform itself from the initial four-node network of 1969 to the multi-million-node ubiquitous infrastructure it is today. What's more, its core protocols (i.e. IP and TCP) have remained largely unchanged throughout this transformation process, thus again demonstrating the flexibility and adaptability of the output of the Internet's standards setting process (i.e. the protocol specifications).

The IETF process[132] indeed differs considerably from those adopted by the more traditional 'official' bodies like ITU and ISO, primarily due to its lesser degree of formality and, probably more important, a different underlying design paradigm. In fact, many single aspects make the Internet standards setting process stand out. These include the extensive use of e-mail distribution lists for discussions, which everyone with an interest in the topic can join, specifications which are openly available throughout all stages of the process, and the requirement for demonstrated interoperability of different implementations (see also sect. 4.1). These features would deserve to be considered more closely by ITU and ISO for integration into their respective processes as well, and have also been called for by number of interviewees from these organisations. Individual participation, as opposed to ISO's and ITU's organisational participation, represents another major difference [Rut 95].

The most important distinction, however, is the Internet's evolutionary and modular design approach. Unlike ISO and ITU, the IETF does not normally attempt to produce all-embracing specifications, but prefers to design relatively small modules that are able to interoperate. This approach enables a flexible adaptation to changing environments even of dated communication protocols[133], and allows to react quickly to emerging new requirements. Moreover, this way an 'installed-base hostility', which may easily be the kiss of death for an otherwise promising new technology, and for which OSI has been blamed by many (see e.g. [Mont 95], [Hans 95]), is avoided. The fact that so far the Internet has been able to scale may largely be attributed to this approach (as suggested e.g. in [Mont 98]).

Still, and despite these very favourable characteristics, one should be careful with an overly enthusiastic evaluation of the Internet's standardisation process, and a few rather more critical remarks should be in order.

Prior to the WWW, the Internet had by and large been a research network, with its governing bodies dominated by people primarily from academia and research. On should think it was a comparably simple and straightforward task to identify the needs of this rather homogeneous research community, and to specify protocols that actually

132 Please note that I am solely referring to the work group level. In particular, I am not discussing strategic foresight (or lack of it) of the IESG or the IAB.

133 Yet, unless adequate precautions are taken, this approach may also cause problems once the whole functionality will be required on a global scale. Moreover, there is the risk of losing the big picture.

address these needs. Standards setting work strived primarily to achieve technical excellence, and was largely uninfluenced by politics and corporate strategies.

The Web, on the other hand, enabled wide-spread commercial utilisation of the Internet, and brought it to the homes, thus opening up completely new markets. Indeed, the advent of the World Wide Web represented a major - if not the - turning point in the Internet's history, the effects of which have already been becoming noticeable in standards setting as well.

As commercial interest in the Internet has been growing, so has the number of members of the IETF work groups, including especially representatives form service providers and vendors. Against this background it may be anticipated that corporate strategies are playing an increasingly important role, and that 'individual participation' will turn into 'organisational representation', yielding a situation not unlike what can today be observed within ISO and ITU.

Similarly, the process' dependence on the availability of 'right people' to do the work - and the chronic lack of them - bears the risk that strong, knowledgeable individuals, backed by interested companies and supplied with sufficient funding, may move into dominating positions within the groups (e.g. by volunteering to do specification and editing work, or by demonstrating working implementations). Ultimately, this could turn an IETF WG into something akin to a corporate R&D group (or maybe a marketing group). These trends have been confirmed, and indeed stressed, by the IETF interviewees, who also note that the current process is ill equipped to address the problems that come with such increased participation and commercial interests[134].

Without formal mechanisms in place to prevent the process from delaying tactics, being taken over by actively participating disruptive people, and/or domination of commercial interests, there is a real risk that what has been considered the strengths of the process in a strictly technically oriented environment (e.g. rough consensus, no

134 The increasing commercialisation may well have consequences well beyond standards setting, and effect the very nature of the Internet as such. The preliminary results of a currently ongoing Delphi survey [Delphi 98], for example, suggest that most experts belief that the Internet will split up into different topical segments, including those for commerce and education, respectively, within the next ten years. The current debate on the proposed Internet II for academic purposes moves along the same line. It remains to be seen how standardisation will be organised within these segments.

voting, openness to anyone) will prove to be major obstacles in an environment influenced by politics.

A recent development in the IETF may serve to underpin this view. It relates to SNMP[135]. Work on SNMPv2, to become the successor to the original and increasingly inadequate SNMP, started in 1992. The core specification was granted Proposed Standard status in 1993. However, it was not accepted by the industry, and very few vendors actually implemented it. Complaints were voiced primarily about the complexity of the design of the security and administrative framework[136]. The WG was rechartered in late 1994, and two competing proposals emerged, which were complemented by two additional positions, including the 'silent majority', representing those who apparently were put-off by the hostile environment that had become the norm in this group, which was monopolised by a few individuals [SNMP 96]. Eventually, the group was abandoned and the SNMPv3 group was chartered in 1997. In early 1998, SNMPv3 specifications were submitted to the IESG for consideration as Proposed Standards. This brief example shows that the IETF is beginning to experience major problems in cases when 'rough consensus' cannot be reached. This may turn out to be a major problem, especially if stakes are high, as they are in the field of network management.

With much of the work of the IETF work groups being done via distribution lists, and with meetings accordingly considered by many as being less important, it should be easier for user representatives to contribute. In reality, however, things look different. Users are as under-represented on the distribution lists and at the meetings as they are on ITU-T and ISO committees. The claim that "everyone can speak", made by several IETF WG members is as true for the IETF as it is at least for ISO. However, this does not imply that everyone actually does speak (or is indeed listened to, for that matter). By and large, vendors, service providers and, to a lesser extent, academia dominate the lists and the meetings, and little, if anything, is being done to change this situation. On the contrary, IETF WGs are experiencing problems as the Internet is becoming commercially more interesting. The IETF's process provides no mechanisms how to deal with 'naysayers' and 'loudmouths', and it does not scale well. These facts may be explained by the history of the Internet, where in the early days some enthusiasts

[135] Simple Network Management Protocol.

[136] This is particularly noteworthy since simplicity and brevity have always been high on the agenda of IETF work groups. On the other hand, the fact that such comments caused the IETF to rethink the proposal and take up specification work again is highly laudable.

would sit down and do the specification of a standard and the hack some time late at night, and that was about it. These days, the process suffers from its legacy; it simply has not been designed to address large, complex problems that come with today's complex IT infrastructure, to deal adequately with the commercialisation of the Internet, and to cope with the increasing number of representatives from vendors and service providers.

Committee members are aware of the overall shortcomings of the standardisation processes. Their suggestions on potential improvements of the processes are generally 'user-friendly', i.e. aimed at simplification and acceleration. Faster processes, better use of publicly available and accessible communication and information services, and increased user participation for requirements compilation and verification of the final product should not least help to attract larger user participation. Yet, these measures, however useful, will contribute little to a solution to the underlying problem, which must be attributed to the structure of the standards setting process as such (see chapter 7 for a discussion of this matter). Thus, it remains to be seen if these improvements ever materialise, and if they are sufficient to actually attract users. In fact, as has been mentioned earlier, it remains to be seen whether increased user participation, without reservations, really is a desirable goal worth striving for.

Assuming for the moment that user participation actually is useful, there remains a lot to be done to convince users of that view. Many user representatives reported very limited interest by their company in standards in general, and even less in active participation. Those who did participate were pretty much discontent with the process, and its outcome. It should be noted here, though, that the latter largely judged the results of the standards setting by the quality and usefulness of the implementations they have in place (or rather by the lack of it). Such problems, though, should be brought to the attention of those organisations in charge of defining functional standards and profiles.

Even if usefulness and benefits of increased user participation have to be questioned, benefits of increased user orientation appear to be beyond doubt. One of the most crucial contributions toward this goal would be to base standardisation work firmly on real user requirements. If this could be achieved standards based products should stand a very good chance of being accepted in the open market. Consequently, all major standardisation bodies have adopted this view, and try to promote user participation in their committees. They also try to make sure, through appropriate rules, that user requirements actually form the foundation of their activities. A glimpse behind the scenes, however, reveals a different picture.

From the comments made by the committee members interviewed it may be concluded that an increase in the number of users on the committees would be met with a considerable degree of scepticism (see below). Most interviewees agreed, though, that user requirements to work from would be most helpful; they also share the official view that such requirements would increase a standard's chance of survival in the market. However, views were split again with respect to how this could be achieved. The list of potential alternatives how to integrate user requirements into, and indeed make users participate in the standardisation process can be summarised as follows:

- **Individual participation by users**
  As has been mentioned earlier - and will be discussed in more detail below - this is not seen as a realistic alternative for the time being. The reasons for the users' absence include the financial burden, perceived as being out of all proportions to the likely benefits, a situation even worsened by the current recession.
  If a single user went that extra mile to try and push requirements in the committees, it would need to be a very large company with sufficient purchasing power to be in a position to make its voice heard. Moreover, technical sophistication would have to be proved to overcome prejudices on the side of the 'techies' in the committees against users who dream up wishlists and subsequently fail to buy what they had previously asked for.

- **Liaisons**
  A committee's liaison organisation receives the output produced by this committee and may participate in the process, but has no right to vote. This could be a very useful mechanism, if it were mandatory to liaise with appropriate user representatives. Unfortunately, it is very much at the discretion of the single committee chairpersons whether or not to liaise, and with which organisation or committee. Moreover, appropriate groups are hard to come by.

- **Dedicated requirements groups**
  Both ISO and ITU followed this approach, and both subsequently disbanded the committees in charge of defining user requirements (or service definitions, as ITU called it), suggesting the value eventually associated with this approach. To make things worse, a psychological problem can be identified here: members of

the technical committees, who consider themselves as those doing the real work, expressed reservations concerning the quality of the output, and indeed the legitimacy of these groups (if they knew them at all; apparently cooperation was not necessarily quite as close as it had originally been intended to be).

- **'Proxy' vendors**
  A very sensible approach, at least in theory, would be to use vendors as 'proxies', i.e. to let them do the work in the committees based on the requirements identified by their user base. Unfortunately, this strategy has potentially disastrous drawbacks. The user just cannot be sure that the vendor will really forward his requirements to the committees. They may, for example, conflict with a larger customers' needs, or with the vendor's strategy, or they may simply be considered as just not worth the effort. Users can exercise little control over vendors in such cases, and they can never be sure if they are really listened to. Moreover, the issue needs to be addressed whether vendors actually can be credible representatives of users who are not their customers.

- **Trade associations**
  User representation through trade associations would overcome some of the problems to be associated with the participation of individual users (e.g. high costs, lack of purchasing power). However, arguments against requirements group would hold as well, and trade associations would have an additional credibility problem in that they represent only their respective particular constituency rather than the user community at large.

- **User coalitions**
  In the case of e-mail, this could be the World Electronic Messaging Associations (WEMA). The major difference to trade associations lies in the fact that they do not represent a particular market sector, but the totality of the members. Indeed, many users surveyed commented that they would consider WEMA as their preferred agent to push requirements in standardisation.

A few additional comments on problems related to the above list should be in order. In a period when even service providers and very large users are struggling to finance participation in standards setting, costs for involvement are all the more significant for smaller companies. As they are likely to have requirements different from those of the large users (see e.g. [OECD 95a]), they will benefit little, if at all, from standards that have been influenced by large users only. In this context, the development of MAP is a case in point; as has been pointed out in [Foray 95], one of its major drawbacks was the absence of small and medium companies during the specification phase. This dominance of sophisticated users contributed in the overly complex MAP specifications. Consequently, mechanisms to enable such companies need to be established. From the alternatives outlined above, it would appear that some form of coalition is the only reasonable way to accommodate this sector's needs.

Another major drawback to be associated with the current approach of a 'techie'-led development can be revealed by a second look at what the usability literature teaches us. Lindgaard [Lind 94b, p. 41], for example, observes that:

"Perhaps most importantly of all, developers often fail to realize that they themselves are not 'typical' end users; they believe that, because they are also computer users, they are so similar to end users that they do not need to verify this similarity through experiments, observations of users, or other types of interaction. They therefore fail to realize that their often implicit understanding of users' needs reflect their own perspective which is not necessarily shared by the end users."

This is exactly what can be observed happening on the technical committees. Technical experts go to these meetings, not senior managers or company strategists [Carg 95], [Alex 95]. They identify requirements - indeed are forced to do so in many cases due to the lack of user representatives. Yet, not only is it questionable whether they really do know sufficiently well what is needed by the human end-user, but their insight into the needs and requirements of even of their own company, let alone others, may also be doubted (the latter being more important in this context).

Whereas usability is very often seen in relation to the human user only, it can be argued that it also has a strong organisational component (see e.g. [Booth 92], [Watad 96], [Nance 96] for more recent analyses). For instance, it is a well-known fact that information technology may have significant impact on an organisation's structure as well as on the nature of work and the distribution of workload [Yav 88]. Other authors (e.g. [Davis 89]) show that perceived usefulness of a system is closely related to its acceptance in the workplace, or identify other pre-requisites on the user's side necessary to make newly introduced IT a success within a corporation [Saga 94]. These few examples should already convey an idea of the complexity associated with the use of information technology in organisations, much of which, directly or indirectly, relates to usability. It is less than realistic to assume that engineers working in the standards setting committees are aware of these implications.

Other research has shown that both the intra- and inter-organisational contexts in which systems are to be implemented must be taken into account prior to and during design (see e.g. [Adl 92], [Pres 95]). This, in turn, implies that even if technical experts in the committees are aware of the needs of their own organisations - and know what has to be done to meet these needs - this does not necessarily imply that the result can simply be applied to other organisations as well. In fact, in many cases the organisations themselves do not fully comprehend their own needs (cf. e.g. [Jak 96a]). It may also well happen that a service or a particular service element is most useful within the context of one organisation, but unsuitable in another. In this case the company-centric approach will not yield any useful results. Unfortunately, as has been discussed earlier, such company-centric views still prevail among committee members, including user representatives. Thus, we have found another strong argument in favour of coordinated user representation in standardisation.

In many cases, requirements contributed by users will be more strategic in nature rather than purely technical. At first glance, this would seem to support the popular approach (as suggested e.g. in [Alex 95] and [Weiss 93]) to leave the technical nuts and bolts, i.e. the 'how' of standards specification, to the technical experts, i.e. the suppliers. Moreover, it has been argued above that requirements will differ significantly between companies. If user coalitions were to channel the needs of their constituencies into standardisation it would be necessary to first align these requirements. Organisational issues would have to be resolved at this stage, and this would require strategists rather than engineers, though not necessarily at the committee level, but at the level of the 'channelling' entity (e.g. EEMA).

If the above scenario were established properly, the resulting construct would very much resemble a dedicated requirements group, albeit one with great responsibilities and, in fact, power. This group would have to provide the initial requirements from which the technical groups could work, monitor the progress and make sure that the technical realisation still meets all requirements. If need be, they would also have to interfere with the technical work, and provide appropriate guidance if they found requirements were not incorporated adequately. This would require considerable technical expertise on this group's side. Thus, the frequemtly made assertion regarding the desirability of the suppliers' sole responsibility for the technical realisation of a standard does not hold.

Apart from the financial, technical, organisational and strategic problems to be solved, a psychological one would still remain. There is a lesson to be learnt from the fact that both truly global players in standardisation decided to disband their requirements groups. Financing participation has been an issue, but I would argue that other problems played a major role as well. In particular, I am referring to the already mentioned problem of these groups' credibility. It may be concluded from the committee members' views on the usefulness and credibility of these groups that a general agreement on the role of such a group would have to be established, that it must be very clear that they are really representing the user community (rather than just parts of it), and that they do have the competence, the strategic and also technical knowledge, if needed, to provide valuable input to the technical work. Interference at technical level should be informed, and be avoided at all if possible.

Even if the process were altered accordingly to better enable user participation, many users, including large ones, would still be happy to have their vendors or service providers decide what they get. In this context the trend to outsource IT departments is a case in point. There is little difference between buying off-the-shelf and outsourcing; both approaches hint at a very limited interest in standards based solutions[137]. In general, the trend towards IT outsourcing is a logical next step for those companies which tended to buy their IT solutions off-the-shelf anyway.

The potential effect outsourcing may have on standards setting is somewhat unclear (if they participate at all in the process, that is). It may be argued that outsourcing companies are better positioned than vendors or providers to represent their clients, simply because they are more familiar with the respective customised services they are offering, and know of shortcomings that may need to be addressed by the committees. If this is the case, they will be in a good position to act as a trustworthy intermediary for their customers. On the other hand, as their function is close to that of a vendor or service provider, they may assume a similar role in the process. In any case, outsourcing companies will face the problem of context-specific and unpredictable requirements identified by their single customers; they too will hardly be in a better position to identify general requirements than a vendor implementing an IT system.

[137] As a brief aside: whilst it may be too early to speculate, I am very sceptical about the long-term effect of IT-outsourcing. With the importance of information technology still on the rise, it may prove disastrous for a company having stripped itself off all competence in this area and being reliant on a third party, the strategic and technical decisions of which cannot be controlled.

A few words should be said regarding the popular suggestion to employ electronic communication media to better support user participation. Whilst this should definitely be done, I do not think that it will help very much, apart from accelerating the process (which could be a good thing). Considering the overwhelming importance attributed to personal presence at meetings, an assessment very much in line with the literature (see e.g. [Mark 94], [Spro 86]), e-mail and video conferences would contribute little in terms of meaningful user participation. On the contrary, it could potentially be used by interested parties to claim increased efforts to enable user input, knowing that this input is likely to be ignored altogether by those who actually attend a meeting.

Finally, one strange observation relating to the participation of users in the technical committees of ISO and ITU, for instance, should not go uncommented. Inadequate technical knowledge on the side of the users was the prevailing argument against increased user participation. The strange thing about this position is that 'technical merits' of a proposal are said to be not that important, at least when compared to 'being present at meetings'. Yet, quite a few of those who rate the technical merits of proposal as less important at the same time argue that users are not sufficiently aware of technical details[138]. Apart from that, especially large users with very heterogeneous IT-environments quite often need to develop highly technical solutions to their communication problems, not least because of inadequate standards or a complete lack of them in a certain field. To consider those users as 'technically unsophisticated' would be plain wrong.

[138] One cannot help but to suspect that 'technical sophistication' is only put forward as an excuse by some in an attempt to keep the number of users on a committee low.

Chapter 7

Overall Analysis, Conclusions, and Future Work

The previous chapters have been concerned with various aspects surrounding the links and associations between users, implementations, innovations, standards and standardisation processes. This chapter will try and demonstrate how these different pieces fit together to form a coherent picture. There are some lessons to be learned from this picture, which will also be discussed.

In particular, I will first briefly recap and review the principal findings of the case studies - and the issues they raise -, which are a major starting point for the subsequent analyses. Some conclusions can be drawn from relating the case studies with findings from the literature on technological innovations, including the necessity to introduce a distinction between 'infrastructural' and 'business relevant' technologies when discussing innovations. Subsequently, the importance of standardisation, and of standards-based components, in relation to innovation processes is discussed. This discussion shows that standards setting committees increasingly complement the user's site of implementation as a source of innovations. In effect, the term 'standardisation' must be added to the right hand side of the innovation equation. This observation gives rise to the question of adequate user representation in standards setting. A 'user coalition', i.e. an entity in charge of compiling, aligning, priorising and representing its stakeholders' requirements appears to be the only meaningful solution. In particular, simply increasing the number of user representatives on standards committees would be counterproductive. This is primarily due to the context-specific nature of requirements, and to the fact that real, non-trivial requirements emerge only after years of experience with, and usage of, a particular system or service. The conclusions reached so far suggest the need for a reorganisation of the standards setting process. The major elements and properties of the new process include a viability analysis to precede the actual technical specification work, which in turn comprises several iterations to allow for emerging requirements to be integrated. Moreover, the implementation of the specification, and its exploitation in a working environment are also integral elements of the suggested process. Contrary to common belief it turns out that a speed-up of the overall process is not necessarily a desirable goal per se.

It has to be stressed here that the conclusions presented in the following are to a considerable degree based on information obtained through the survey I did, and thus refer to electronic mail systems in large, international organisations. Likewise, only four major standards setting bodies were studied (ISO, ITU-T, IETF, and ANSI). Thus, conclusions drawn are valid only with these qualifications and should not be generalised. Additional future work will be necessary to establish if (some of) these conclusions are valid for other technologies, different environments, and other standardisation bodies, respectively, as well.

7.1 Issues Arising from the Case Studies

The findings from the survey establish the empirical basis for the subsequent analyses. The major findings, plus the issues they raise, will be addressed in this section. They may contribute to a rethinking of the structure of the standards setting process in general and the issue of user participation in particular.

Within most companies the introduction of corporate e-mail followed a hybrid strategy, typically comprising four distinct, though normally overlapping phases. In these companies early initiatives introduced e-mail at departmental or site level, without any overarching corporate strategy. This happened in parallel at different sites, and eventually resulted in compatibility problems due to the different types of systems purchased. The resulting problems - it was not unusual for a company to have more then ten different e-mail systems in operation at the same time, interconnected through point-to-point gateways - led to severe internal and external communication problems and eventually caused central IT departments to interfere. Following that, a centrally managed backbone (typically X.400-based) was introduced, and attempts were made to reduce the number of local systems supported. Finally, some of the more technically more sophisticated companies recognised e-mail as a mission critical service and started integrating it into their business processes.

A different introduction strategy could be observed at a few companies that are either smaller or were founded comparably recently. They pursued a top-down strategy, thus avoiding some of the problems mentioned above. However, this held only for the first system generation, subsequent upgrades (e.g. from mainframe-based systems to LAN-based ones) caused problems similar to those outlined above. Moreover, the degree of acceptance appeared to be poorer compared to the bottom-up alternative.

These typical 'corporate histories' of e-mail may help explain another result of the study. The vast majority of user companies does not have any major functional requirements on e-mail systems which have not already been covered by the functionality specified in the standards (X.400 in particular). Almost all requirements that are not met can either be attributed to incomplete implementations of the specifications, or must be considered as being outside the scope of a standards document as they relate e.g to local implementations[139]. It appears that more sophisticated requirements will only emerge if the system is integrated into business processes.

The study also sought to address the engagement of users and their approach towards user requirements in standards setting. Many popular preconceptions on how standards committees work were confirmed by the committee members themselves. For instance, decisions within the committees are taken for a variety of reasons, technical merits being but one of them, with outspoken supporters being more important for a proposal to be accepted. Both the statistical information obtained through the survey and comments made by respondents confirm that committees are to a considerable degree dominated by seasoned veterans who know all the nuts and bolts of the process (with the exception of the IETF, where the young age of the organisation is reflected in both the average age of the single work group members and their short average time of association with the IETF). Likewise, the views expressed by many interviewees back the notion of a process being far too slow and painstaking to meet the fast changing demands of today's market and the speed of technological progress. To improve this situation in the short term, suggestions made by respondents ranged from better use of electronic communication media to free

[139] The two exceptions concern message transit times and, particularly, user-friendly addressing.

availability of the documents, not least to elicit public comments. In fact, whilst most suggested improvements were of a rather 'tactical' nature, the broad consent regarding shortcomings of the processes indicates the urgent necessity for improvements.

Exploring the attitudes of both users and standards committee members regarding the pros and cons of (increased) user participation in standard setting revealed that most committee members would generally welcome an increased participation of user representatives in the groups, the major motivation being the hope to learn about real-world requirements. Many feel that committee work is too far removed from the users. However, this is not an unconditional welcome; popular reservations include the request for a clear mandate, continuing participation and adequate technical knowledge on the side of the user representatives. Most users, on the other hand, do not appear to be very much interested in 'wasting' scarce resources on participation in standardisation. Rather, they look to their service providers or vendors if problems occur, or possibly even try to solve these problems in-house. Only a handful of very advanced users, or those that have a vested business interest in the technology are actually sending representatives to committee meetings. This lack of user involvement may be expected to have considerable impact on the standards setting process; the exact nature of which needs to be analysed.

The remainder of this chapter will show how the different topics addressed in the survey fit together, and how they relate to the body of available literature. I will discuss the conclusions that can be drawn, and relate them to ideas and findings from the literature where they are available and where such a comparison seems to be appropriate. In particular, I will show the close association between the processes of implementation and of standards setting, identify their correspondences and differences, and highlight the lessons that may mutually be learned.

7.2 Innovations

Standardisation must in fact be considered as an important contributor to - or even a particular form of - innovation. An innovation owes its existence to its creators' hope to achieve some kind of progress. A reactive standard, for example, may end a period of confusion about the future prospects of competing technologies; an anticipatory standard may enable wide access to completely new technologies and indicate the need for future technological innovations on the user's side.

A users' specific needs and requirements regarding IT systems are not normally fully understood prior to system implementation[140] (see also chapter 2). Two different mechanisms may be identified that influence the requirements a user has on a corporate IT system. First, usage contexts changing over time will result in equally changing requirements. Secondly, requirements may change within each such context, as experience in system usage grows and new ways of system exploitation are found. Moreover, many of these changes may be induced from the outside (e.g. through new technologies or requirements from business partners) and are thus both inevitable and unpredictable from the outset. This, in turn, suggests that top-down strategies for the introduction of highly distributed, de-centralised and only loosely coupled systems such as e-mail may in fact be not too beneficial in the long term. The benefits typically associated with top-down strategies (including smooth introduction and homogeneous systems causing little technical problems) are not likely to last very long. In fact, they may not last long enough to compensate for the strategy's potential drawbacks, which include resistance to change at unit, departmental or individual level as well as a lost opportunity for individual and organisational learning. As one possible result of a top-down introduction strategy organisational learning is confined to single-loop learning (at the very best), whereas a decentralised structure promotes the more desirable double-loop learning[141].

These rather more theoretical considerations have been confirmed by findings from the case studies, which show that it may well take a number of years following the initial system implementation until specific corporate-wide requirements have been identified (see section 5.2 and e.g. [Hans 97], [Jak 96a]). For example, the e-mail system in a large organisation has typically been shaped by a sequence of different and changing environments within which it had to be implemented and run. These environments differed widely in terms of e.g. technological and organisational contexts. In many cases e-mail was originally implemented at departmental level. In some of these cases systems were chosen to meet department-specific, possibly unique requirements, reflecting the respective local contexts. Rather more commonly, however, they just happened to be available eventually, almost by accident (see sect. 5.2). The integration of those departmental systems into a corporate-wide installation represented a major switch of contexts, and accordingly a change of requirements. As a result, the

140 This holds for other technological systems as well, see e.g.[Deiß 92].

141 With single-loop learning errors are detected and corrected, but the correction has no impact on the company's policy. In contrast, double-loop learning involves questioning and potentially subsequent modifications of a company's policies and goals as result of the error [Bala 96].

desirable characteristics of the system changed dramatically, and another phase of the overall implementation process had to be initiated to accommodate the new context. Subsequently, other context changes occurred, e.g. through the need to communicate with the outside world, and especially to open the internal system to customers and business partners.

Further findings from the case studies show that companies could pursue a top-down introduction strategy only for the first generation of e-mail systems. Subsequent implementations followed the same patterns as did their counterparts in those organisations which followed a bottom-up 'strategy' from the outset. That is, implementation of later systems generations were likewise triggered by internal or external needs rather than deliberate strategic planning, which resumed only within some companies at a later stage when other usage contexts were considered, possibly also as a result of some organisational learning.

Infrastructural Technologies

A remarkably indifferent attitude regarding corporate e-mail has been demonstrated by most companies. This comes as some surprise especially since a massive body of literature exists on the diffusion and management of innovations, providing guidelines on how to introduce, utilise and manage corporate IT, as well as the organisational changes potentially induced by IT systems (see e.g. [Dani 94], [Gatt 90], [Ham 95], [Martin 94]). The search for an explanation for this apparent lack of interest first leads to the observation that large organisations deploy technology in very different contexts for very different purposes. This holds for technology in general, and all the more for information technology. IT artifacts can be found on plant floors, in R&D labs, and on secretaries' desktops; the different purposes they serve include production automation, number-crunching, and accountancy.

Despite these different application areas, at a very general level IT artifacts may be categorised as being either 'specific' or 'generic'[142], i.e. 'business relevant' or 'infrastructural'[143]. A car manufacturer's robot may serve as a representative of the

[142] The term 'generic' will not be used here to avoid any confusion regarding its meaning. In the SST literature (see e.g. [Fleck 92]), this term is frequently used to denote systems exhibiting a degree of overall system-level standardisation. Its meaning here is different, referring to a system not directly linked to a company's business. Hence, the term 'infrastructural' will be used subsequently.

[143] For a similar categorisation see e.g. [Ben 93]. Benjamin distinguishes between 'hard infrastructure' and 'value-added business applications'.

former, a secretary's fax machine as a typical example of the latter. In particular, a company's communication system (e.g. the internal telephone network, or the corporate e-mail system) is in many cases considered as being infrastructural technology. In terms of innovation theory, the major distinction between these categories is their different degree of exposure to context-specific requirements. That is, business relevant systems are very much shaped by the particular environment within which they are deployed. In contrast, requirements on infrastructural technology will not vary much between contexts, a common characteristic of which is the fact that within most companies they are not, or only to a very small extent, integrated into business processes. Figure 7.2.1 attempts to illustrate the distinction between 'infrastructural' and 'business relevant' (IT) technologies.

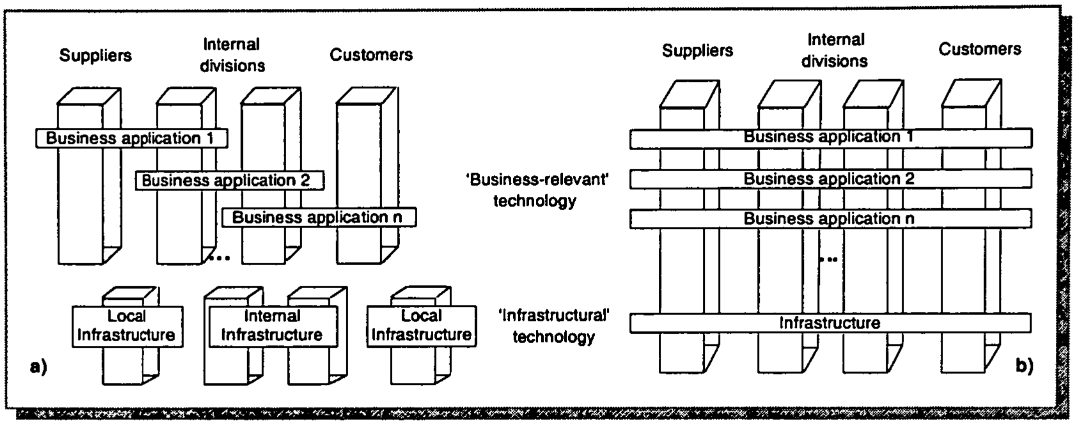

Figure 7.2.1: 'Business Relevant' vs 'Infrastructural' Technology
(based on [Ben 93])
a) Typical situation today - separation of, and mismatch between, infrastructure and applications
b) Ideal situation - integration of common infrastructure and applications

Figure 7.2.1a shows how an organisation's IT infrastructure[144] and its business relevant applications are typically separated; in most cases they have been developed independently. The infrastructure should be transparent for the application and the user by offering both the functionality and the performance necessary to make distributed or remote applications appear to be installed locally. It should also extend across organisational boundaries. This situation is shown in Figure 7.2.1b.

The need to quantify the corporate benefits to be gained from enhancing such infrastructural services in several cases hampered attempts to upgrade corporate e-mail systems, which are widely considered as part of the 'infrastructure' (for a similar

[144] The term 'infrastructure' denotes all communication oriented functionality that can be used by an application. In terms of the OSI-RM, this covers the full seven layer stack.

account see also [EEMA 94a])[145]. Investments in this area are hard to justify as they will yield largely indirect or intangible benefits[146]. Indeed, most companies represented in the case studies adopted a very reactive approach towards infrastructural systems. That is, although infrastructural technology may well have been enhanced to meet identified new requirements, in a vast majority of cases this only happened once the situation had become intolerable (e.g. through an unacceptable percentage of lost messages). Likewise, in terms of Ward's cyclic model of an application[147] (depicted in Figure 7.2.2a, see also [Ward 87]), e-mail belongs into the 'support' cell, which again points to its (current) infrastructural nature. However, it should also be noted that deployment of corporate e-mail does not normally follow Ward's application life cycle. Rather, the typical development of corporate e-mail (see sect. 5.2) suggests that Ward's cycle should actually be a spiral (as depicted in Figure 7.2.2b).

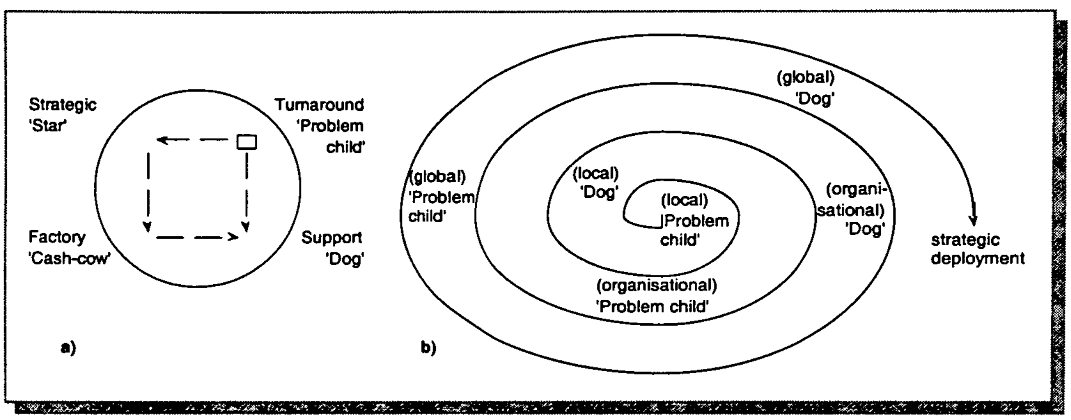

Figure 7.2.2: Application Life Cycles
a) For applications (according to [Ward 87])
b) For e-mail (according to my case studies)

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145 Firms invest where they perceive they will get benefit. However, their perceptions are not necessarily based on rational calculation. In the context of incomplete information - which must be assumed here - we see that decisions are shaped by other factors - 'fashion trends' and media hype play a role, too ([Will 97b] see also sect. 2.1.2).

146 The directory service is an illustrative case in point. It has thus far received extremely little corporate attention by most; in some cases, it has been installed only because it came for free with some other system. This holds despite the general perception of those respondents who are in charge of managing corporate e-mail systems that an adequate directory service is becoming increasingly crucial for the smooth functioning of their company's communication infrastructure. Indeed, the existence of an adequate global directory service has been considered a necessary condition for the further emergence of the global information infrastructure [CEU 95], [ANSI 96b].

147 Ward's model assumes that an application starts life as a resource consuming 'problem child', becomes a strategic 'star', still costly, but now generating high benefits. Subsequently, it turns into a 'cash cow', generating high benefits, but using few resources. Finally, it becomes a 'support' application, no longer critical, but still valuable. Each application traverses this cycle exactly once.

To summarise: we have identified a need to differentiate between categories of technology. Two such categories can be distinguished; technological artifacts may be either 'infrastructural' or 'business relevant'. Less specific requirements may be expected for the former, due to an environment which is more consistent across departments, companies, and even business sectors. On the other hand, the environment of the latter typically exhibits strong, organisation-specific particularities, and thus a need for local innovations. Users appear to be more prepared to invest in 'business relevant' technologies, where potential return on investment is more obvious and tangible. Moreover, with requirements on the underlying infrastructure being less specific in most cases, comparably straightforward installations may be feasible here.

The above findings suggest that Biervert's observation that *"... it is unusual for a firm to go into developing and pursuing strategies for the development of technology when its main line of business lies elsewhere ...."* [Bier 92] is not quite correct. Rather, irrespective of a company's core business it appears that the perceived strategic importance of an IT system is the yardstick by which a company's willingness to start its own development activities has to be measured - i.e. whether it is classified as 'business relevant' or 'infrastructural'. Accordingly, a specific e-mail strategy requires the recognition of e-mail as a strategic service in the first place. Neglecting the crucial enabling role of an adequate infrastructure has in many cases led to an environment suffering from the fact that investment in infrastructure technology was given low priority [Ben 93].

Business Relevant Technologies

Which technological systems are actually considered as 'business relevant' by a company very much depends on the respective organisation's commercial interests. Accordingly, this will vary between companies; a car manufacturer, for example, may look to robots or systems for Computer Integrated Manufacturing (CIM), a publisher may be interested in Desktop Publishing equipment, and an innovative bottling line might attract a brewer. However, 'business relevant' has a broader scope than these purely production-oriented technical systems. In the service industry EDI may well fall into this category as well. In the banking and retail sectors, for example, EDI has already streamlined both intra- and inter-organisational processes to a considerable extent, a development which may be supposed to continue [Webs 95][148]. The same sector was, for instance, among the earliest industries to use mainframes, which have

[148] For a detailed discussion of the issues surrounding the social shaping of EDI see [Will 95a].

long since been seen as being crucial thanks to their ability to process massive amounts of financial transactions and to handle large volumes of data [Barra 94]. In particular, this shows that a system considered by one company as being 'business relevant' may well have 'infrastructural' status for another, a phenomenon that may, for example, be observed in the case of e-mail where perceptions regarding its business value differ between firms.

For each company technologies that relate to its core business - and its core competence - will naturally attract most interest, particularly if they hold the prospect of a quantifiable return on investment. Busch [Busch 89] notes that although demand for standard software has been growing faster than that for special customised software systems, tailor-made solutions are still preferred if the system is "*... affecting the primary business of firms, especially for areas closely linked to production and marketing ...*".

Very specific requirements and processes are most likely to have been developed primarily in the areas of a company's core business interests. These, in turn, stand in the way of a straightforward installation of a system. It is here where long-standing, time-honoured traditions characterise the environment, and where technical systems as well as production and business processes have been designed to optimally meet the demands of their specific environment. A new system to be implemented here will have to be customised to a similar degree as have been the other artifacts in this environment. Accordingly, efforts will have to go into the design of a dedicated system, and its subsequent integration. Accordingly, it may be concluded that innovations[149] are most likely to occur under these circumstances, i.e. when 'business relevant' technology is to be implemented[150].

The case studies have also shown that only those few companies which consider e-mail as a strategic tool, i.e. as 'business relevant', are prepared to implement a system that really meets their needs. This situation is highlighted by the representative of one of these companies, who remarked that his organisation frequently had to build its

[149] Likewise, this is where innofusion occurs, i.e. user triggered innovation during the process of implementation, necessary to meet particular context-specific requirements [Fleck 88].

[150] Indeed, it appears that recent research into innovations has almost exclusively focussed on what must be considered as 'business relevant' technologies, including robots for manufacturing plants [Fleck 88], EFTPOS-systems in retailing [Howe 91], corporate cash management, home and office banking [Finch94] and ATMs [Scar 94] in banking, and CIM in manufacturing [Blumb 94].

own innovator level tools to achieve the desired functionality because of inadequate products. In contrast to that, the case studies revealed that where an e-mail system is not considered as 'business relevant' it has been a matter of buying it off-the-shelf.

This observation brings us briefly back to the classification of visions regarding corporate IT infrastructures which has been discussed in chapter 2, i.e. 'independent' (no relation between IT infrastructure and business strategy), 'reactive' (strategy shapes infrastructure), and 'interdependent' (mutual shaping). It appears that given the above classification, most companies are still at level 1 (independent), at least as far as their use of e-mail is concerned.

As most authors discussing the theory of innovation have so far failed to address infrastructural systems it appears that a closer cooperation and interaction between business studies, as represented e.g. by [Venka 91], and social sciences in general and SST in particular would be very fruitful.

7.3 Standardisation, Innovation and Implementation

It appears to be safe to say that standards-based components are going to play an increasingly important role in implementation processes. However, it is not yet clear how these different processes relate to each other.

In those cases where a suitable combination of standardised components meets the needs of a particular environment, standards establish the framework within which the implementation takes place. This is most likely to happen in the case of 'infrastructural' artifacts or systems. Alternatively, especially if 'business relevant' systems are concerned, standards may be considered as contributors to a system implementation, and to potential innovations. This contribution is likely to be through single component standards, as overall, system-wide standards are most unlikely to materialise for complex IT-systems[151]. Yet, in this case these components will only play a minor role in the overall implementation.

[151] The notion of a system-wide standard implies that this standard needs to be unique, i.e. no other standards with the same (or a very similar) scope may be available. In the case of e-mail, for instance, X.400 has the *potential* of being a system-wide standard. However, there are also different LAN-based systems and SMTP (the latter being a - competing - standard in the sense of the definition of a standard as given in sect. 2.1.1.1).

The implementation arena as a major locus where innovations currently materialise - and where the social shaping of technology accordingly takes place - is to some extent complemented by activities within the standards committees in which the underlying groundwork upon which innovations will draw is done (see also e.g. [Proc 96]). In the case of electronic mail systems, for instance, much of the underlying communication-oriented systems exclusively comprise standardised services. Regarding the more application-oriented parts of the overall system, i.e. the e-mail service itself, we note that implementation-specific particularities become more important; it is primarily at this level where the integration into the existing IT environment takes place, and where accordingly innovations will (have to) occur. This holds all the more for applications utilising e-mail.

In any case, it follows that standardisation processes are important for innovations, and that they must not be ignored when discussing innovation processes. I would like to take this argument one step further and suggest that major similarities exist between innovation and standardisation processes. Indeed, it may well be possible that lessons learned from the well-researched field of innovation may be applied to standardisation processes. This proposition may appear to be a little far-fetched; after all, there is a major, decisive distinction between the processes of standardisation and innovation - their respective scope. Whilst this is certainly true - and will be discussed below in more detail - there are indeed also major similarities between the two processes.

For one, users have a considerable influence on innovations. In fact, they could establish themselves in a position to dominate innovation and standards setting processes alike. As it currently stands, however, users' diverse and individual needs prevent them from playing the important role they could play - at least in standards setting.

Members of standards setting committees tend to see themselves as company representatives (see sect. 6.3). This holds particularly for members from user companies. It may accordingly be concluded that they only contribute specific requirements that originated form their respective environments[152]. It follows that here the local environment of the respective user representative's organisation has a major impact on the standards setting process in that they heavily influence the user

[152] For some supporting evidence from the survey see sect. 6.2.2.

requirements that are actually fed into the process. This impact in fact represents another correspondence between standards setting and innovation[153].

Moreover, both standardisation and implementation are major platforms for cooperation between vendors and users. Without this cooperation the outcome of the processes would most likely be far from satisfactory, due to the complementing roles users and vendors play, which are equivalent in both processes. It is the vendors' task to provide the technical knowledge and expertise. Users, in turn, contribute their specific knowledge about their requirements and environments, respectively[154].

These complementing roles imply that communication between the two parties is crucial in both processes. The 'technology-centric' view of the vendors needs to be aligned with the organisational and technical requirements of the users, a process that is essential during both implementation and standardisation, albeit with somewhat different foci. During implementation vendors need to gain a good understanding of the particularities of the context within which an innovation is to be implemented. Consequently, an active learning process has to take place on the side of the vendor. In standardisation users need to contribute their specific requirements to the process; users assume the teacher's role here. Still, the underlying common need for communication remains.

Other factors that may shape technology will also be channelled into the work groups of the international standards setting bodies. The respective corporate environments of the committee members' employers, for instance, will play a major role in this context. The different visions of how a technology should be used, and the ideas of how this can be achieved are both formed by these local environments. It will exert a significant impact on the work of the committees, thus preceding, and possibly complementing the local implementation context as a major source of influence. This holds especially in the case of anticipatory standards, which specify new services from scratch, and thus offer the opportunity to incorporate the particular presumptions of the originating committee to some degree. In a more extreme case, work within the committees may

[153] It should be noted, though, that whilst specific needs are important for the implementation process to enable a technology to be optimally tailored for a given environment, at the same time it helps prevent stronger user influence in the committees.

[154] However, a reasonable level of technical knowledge on the users' side is necessary to enable them to judge the technical quality of an implementation. Likewise, it would be helpful if a vendor had a degree of understanding regarding the general characteristics of the respective environment within which the implementation will be done.

even anticipate innovations that could otherwise potentially result from a local implementation. This may, for instance, happen if a strong user representative succeeds in promoting the particularities of his/her local environment as the basis for a standard.

A reactive standard will likewise transpose the environment from which it emerged; this will typically be the corporate environment of its inventor (i.e. typically a vendor or a service provider) who originally specified the system upon which the standard will be based. Thus, his/her visions will implicitly be embodied in the standard specification. Again, the correspondence between innovation and standardisation is obvious - both are shaped by a specific environment. Only in this case it is the vendor's environment that has a major impact on the standard.

Related to these observations, although on a personal rather than organisational level, we note that the processes leading to both technical design and technical standards are typically dominated by engineers, who in many cases lack an understanding of the non-technical components that need to be considered for both designs and standards alike. The accordingly rather 'technology-centric' outcome of both processes has frequently been criticised.

We can conclude that the work done within the standards committees has a major impact on innovations (in addition to design and the actual implementation itself). These activities are not unrelated; even local implementations of individual, customised systems are likely to include standards-based components. Standardisation will always influence innovations, either:

- directly, e.g. if a local implementation is done through integration and configuration of standards-based components[155], or
- as the basis of system design, in case of a customised solution comprising some standard elements being implemented, or
- as the locus of inventions[156].

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155 However, the local implementation will based on components designed elsewhere, and bought off-the-shelf by the implementor.

156 These inventions may subsequently be incorporated into innovations.

This observation suggests that the term 'standardisation' has to be introduced into the innovation equation:

Innovation = Standardisation + Design + Implementation.

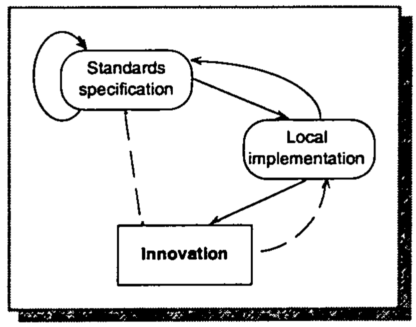

Figure 7.3.1: Processes Contributing to an Innovation

Figure 7.3.1 depicts the close interrelation between the processes of standardisation and implementation, and the (potentially) resulting innovation. In fact, given the large number of standardised components available, the odds are that every innovation in the IT sector will at least in part be influenced by standardisation. It is time to turn to an analysis of the process of standardisation to gain some more insight into the particularities of the process, and its influence on innovations.

7.4 Users and Standardisation

So far the discussion suggests that the contribution of specific knowledge regarding the characteristics of the respective implementation environment represents the major role users have to play during an implementation process. That is, they have to feed their intimate knowledge of local particularities, which nobody else can possibly possess, into the process. Given the interrelation and similarities between implementation and standardisation processes, we may assume that users should be assigned an equivalent task for standards setting, again to optimally exploit their unique knowledge on their respective local environment[157]. For standardisation purposes, this knowledge ideally takes the form of functional requirements, which then establish the basis from which standards can be developed. This conclusion is supported by practitioners and standardisation theorists alike; a majority of survey respondents, for example, have stressed the fact that to them contribution of real-world requirements constitutes the major role users are supposed to play in the process

[157] A discussion of the relevant differences between standardisation and implementation - i.e. especially the different scopes - will be given further below.

of standardisation. For similar views expressed in the literature see e.g. [Alex 95] or [Isaak 95].

Yet, we have seen earlier that 'requirements' is a very broad term, that not only refers to the technical domain, but is also closely linked to the particularities of the respective local environment. Accordingly, providing only functional and technical requirements does not suffice. Rather, organisational and other non-technical needs have to be considered, and user representatives need to be in a position to identify these needs. Thus, it would not make too much sense if only technical people were sent to the committees to represent users. Rather, corporate strategists and managers also need to get involved, to make sure that the non-technical issues are adequately covered as well [Alex 95].

If a user actually does participate, assuming the role of a user representative, as opposed to representing only a single company[158], survey findings show s/he will face credibility and communication problems. First, many respondents said they would need to be convinced of a proper mandate, to show that not just a particular company's special requirements are brought into the process, but more widely identified needs[159]. Typically, companies are sending their engineers to standards committees, and their views tend to be somewhat 'techno-centric' [More 96]. Thus, it is not too surprising that committee members have named technical sophistication on the side of the user representatives as a major prerequisite for meaningful participation. Thus, it would be necessary to convince committee members that representing a user in a standards committee does not necessarily require technical expertise, and that there are more aspects to standards than just purely technical functionality. Failing on the users' side to adequately address these issues will invariably weaken their position in the committee[160].

158 I will come back to this critical distinction further below.

159 It is worth noting here that apparently no such mandates are necessary for representatives of vendors and service providers. This may again be interpreted as an expression of the predominantly 'techno-centric' attitude of standards setting committees, whose vast majority of members is representing vendors or service providers. Their roles have never been questioned, although they obviously include the representation of the respective employers' commercial interests (which may or may not be in line with the overall best interest).

160 It is worth noting here that despite the frequently voiced condition that users need to be technically sophisticated committee members also reported that a proposal's technical merits are significantly less important than the presence of its proponents at meetings (with the exception of the IETF, where technical merits is the one thing that counts). It might be suspected that 'technical sophistication' is put forward as an excuse to help keep users away from the committees. This would, however, need further data to work from.

A major underlying obstacle here is rooted in a communication problem, and in the differences in views and perceptions of technology that can be identified between engineers and managers. Such problems in 'cross-profession' communication are not uncommon (see e.g. sect. 2.2), to solve them requires learning by all sides; engineers need to gain some understanding of the necessary organisational and managerial considerations, and managers need to get an understanding of at least the technological basics. This may sound trivial, but the reported major credibility and acceptance problems from which ITU-T's Study Group I, and its ISO sister group, suffered finally contributed to the abandoning of these groups (which had been charged with specifying user requirements, see sect. 6.2).

As a consequence of the typical history of corporate deployment of e-mail, and of its perception as being primarily infrastructural, users will not only be unable to contribute initial requirements to a new standards setting initiative (others than very general ones), but they will also be unable to provide useful input for quite some time afterwards[161]. This situation can only change if and when the status of e-mail (and of other IT systems with a similar corporate history) switches from 'infrastructural' to 'business relevant'. Even if this happens, it will subsequently take a considerable period of time to actually identify new, more advanced requirements. Although some are likely to emerge during implementation, others will only surface once the system has been adapted to, and especially integrated into, the local environment (e.g. into business processes) and experiences have been gained through its use, a process which may well take years.

If users are not (yet) in the position to contribute requirements, the standards setting process will not benefit very much from their participation. Therefore, we may conclude that in this case it will make little, if any, difference whether or not user representatives participate in the process, since they can only assume the role of technical experts - rather than that of a contributor of requirements - many of whom will be on the committee anyway (representing vendors). It follows from the above that this situation may easily occur in case of 'infrastructural' technologies, where

[161] It has been shown (in e.g. [Jak 97a]) that it may well take years for an organisation to develop a reasonably good understanding of its technical requirements on e-mail (see also sections 5.2 and 5.3; only a very small percentage of the companies represented in the survey were in a position to identify more advanced requirements even after several years of usage).

users do not see any business incentive to contribute to standards setting[162]. This additional lack of incentive comes on top of the reluctance caused by the general perception of the standardisation process as slow, inefficient, costly and yielding uncertain results (see e.g. [Ferné 95]).

The generally accepted principal role for user representatives in standards setting is to provide real-world requirements (see e.g. [Alex 95], [Carg 95], [ETSI 92], [Naem 95], see also sect. 6.2). However, in most cases specific functional requirements are not normally available at the beginning of a standardisation project. Moreover, from the above discussion we have seen that unconditional user participation in standardisation is not a desirable goal per se, thanks to the largely context-specific - and thus very diverse - requirements that are to be expected. Instead, ways need to be found to achieve meaningful user representation.

The transition from a single, possibly largely configurational system to a universally useful generic service - such as specified by a standards setting committee - introduces a range of additional conditions and aspects that need to be addressed. Initially, an innovation may need only to be considered within a specific context[163] (e.g. a single organisation), whereas standardisation addresses a far broader and more heterogeneous environment. An implementation takes place within the well-defined context of one single setting, taking into account, and being rooted in, its local characteristics and specifics. In particular, this holds for the identified functional requirements, which basically establish the technical aspect of the local context, and are identified by the one customer where the implementation takes place. In contrast, a standard needs to be useful to, and applicable by, a wide range of organisations across very diverse contexts. A broad range of potentially very different requirements from equally different environments will need to be addressed. Standardisation cannot try and accommodate some of these while ignoring others; rather, it has to be sufficiently generic[164] to be easily adaptable to a variety of - ideally all - contexts.

162 It would be interesting to study the participation of directly affected users in other domains. The survey results suggest that users' incentive to actively participate in standardisation increases if a technology is perceived as being 'business relevant'. This seems to hold even for user SMEs, which do not normally get involved in standardisation.

163 However, an innovation may eventually be made more generically applicable.

164 The use of the term 'generic' already hints at certain analogies between a standard and a 'generic' system according to [Fleck 94]. Both exhibit a degree of system-level dynamics, and trajectories of development can also be identified for both. However, this correspondence would need some further deliberation.

An implementation process is inevitably bound to fail if there is no user participation; the involvement of numerous user representatives from different backgrounds significantly contributes to its success. Yet, the attempt to increase user influence in standardisation simply by raising the number of users on a committee will introduce a variety of additional, probably contradicting requirements. They may lead to highly complex standards, offering numerous alternatives and optional functionalities to suit all needs[165]; almost inevitably this would introduce incompatibilities between standard-compliant systems simply because of the different options that could be implemented, as it is the case e.g. with EDI standards (see e.g. [Kubi 95b]). Against this background the frequently claimed need for more users on the standards setting committees (see inter alia [ETSI 92] and [Ferné 95]) requires some further analysis (see also [Jak 97b]).

Given the huge variety of business sectors, organisational forms and business philosophies, the many different intra- and inter-organisational interdependencies, and all the differences that come with varying company sizes [OECD 91], [OECD 95a], not to mention regional or national differences in culture and legislation [Mart 96] it is most unlikely that coherent requirements will ever materialise, apart from some very generic ones[166]. Moreover, representatives of user companies do not necessarily see themselves as user envoys in general; rather, they are representing their respective employers (see also sect. 6.2). Therefore, there is a need for a mechanism to align the various requirements.

These considerations suggest that users should seek representation through a dedicated body (a 'user coalition'), responsible for voicing its stakeholders' needs and concerns in the appropriate standards committees[167]. In the case of electronic messaging, for instance, this role could be played by the various Electronic Messaging Associations. In any case, great care needs to be taken to ensure that such a body actually represents as broad a variety of users as possible, of all sizes and from all sectors, rather than acting as something similar to, say, a trade association representing only a single

[165] In fact, today's process tends to yield such results as well, the parallel standardisation of the three competing LAN technologies Ethernet, Token Ring and Token Bus to please DEC, intel, Xerox and IBM and General Motors, respectively, being a case in point.

[166] Such generic requirements may well lead to systems that perform well as 'infrastructural' technology within the framework of the originally envisaged applications (i.e. e.g. interpersonal messaging in the case of e-mail). Problems will arise if and when this system is either to be adapted to a specific (local) context, or if it is to be employed outside the original framework.

[167] For a similar account see also [OECD 96b].

market sector[168]. This broad market coverage is crucial for several reasons. For example, even basic requirements will differ between SMEs and large enterprises[169].

In fact, a user group[170] shares many characteristics with a user coalition - albeit in a different context - in that its scope is strictly limited to one product and one supplier, respectively. From a vendor's point of view these groups provide invaluable feedback, including for instance on bugs, but also on requirements on future releases or new products; here users play a role very similar to the one they should play in standards setting. Depending on the type of product, membership in these groups is very diverse, covering different industry segments and very distinct types of user companies. Thus, the diversity of users found to be crucial for user coalitions can be found here. Users, on the other hand, feel that membership in these groups is advantageous, and that vendors listen to what the groups say (see also sect. 6.1). It would therefore be extremely beneficial for the standards setting process if a similar situation could be created there as well.

There is also an economic dimension to this way of user representation, in that it offers the almost only realistic chance for those user companies which cannot afford direct participation to have their requirements filed with standards committees. Again, this holds particularly for SMEs, almost all of which currently stay clear of any standardisation-related activities. Finally, it will serve to reassure other committee members (i.e. representatives from vendor companies) that indeed a broad base of users is represented. Clearly, the alignment of requirements has to take place prior to actual standardisation to enable the user community to file an agreed set of requirements, and to speak with one voice.

The observations above trigger some further thoughts regarding the general desirability of direct user participation in standards setting, and indeed on the overall structure of this process.

168 User groups for certain (proprietary) products play a similar role today. Here, the respective vendors are the prime beneficiaries, but the underlying idea is the same in both cases. For a discussion on the risks associated with using vendors as proxies see e.g. [Jak 96g] and sect. 6.1.2.1.

169 In an attempt to generalise and classify user needs, Rothwell suggests a scheme comprising of price and non-price factors [Roth 94]. However, this classification fails to include any functional requirements, which renders it useless at least for the problem at hand, if not in general (except maybe for economic considerations).

170 Typically a supplier-initiated organisation of users of e.g. a particular product or service.

7.5 A Proposal for a New Standardisation Process

The most frequently heard complaint about the process adopted by the 'official' standardisation bodies concerns their slowness and their lack of responsiveness to market needs and technological changes [Aiken 94], [Besen 95]. Another point raised regularly is the danger of losing out to 'de-facto standards', i.e. proprietary specifications or those developed by a consortium, which might, due to their speed of work and their commitment, eventually render the 'official' process obsolete. Indeed, this criticism seems to be justified given the lengthy and highly formal processes adopted by most standards setting organisations and ever shorter technology life cycles. However, in the light of the survey findings some reservations regarding these perceptions are appropriate.

We have seen that the implementation of a corporate IT system is far from being a simple and straightforward exercise. In many cases it starts as a highly distributed process, which only at some later stage may become largely centrally organised and managed. In the case of e-mail it typically took five to ten years before central IT took over [Jak 96b]. Since then, few of the organisations represented in the case studies have managed to harmonise their system to the planned degree, let alone to actually integrate e-mail into their business processes (if they intended to do so at all, that is). It is only now that these few pioneering companies are in the position to identify functional deficiencies of the system, and can take appropriate action. One possible option at this stage - and actually pursued by some survey companies - is to contribute these requirements to the standards setting process through active participation. Two conclusions may be drawn from this observation:

- Users are hardly in a position to come up with meaningful specific requirements on a communication service if they have not already put the service in question (or a reasonably similar one) to more advanced use.

- It takes years of advanced service usage to reach this level of sophistication.

From this it may in turn be concluded that pro-active standards cannot simply be designed on the basis of real user requirements because such requirements will not normally be available when standards are initially developed. This is underpinned and further stressed by the comparably general and sketchy level of the requirements compiled through the case studies even from long-standing users. Consequently, just speeding up the standards setting process will not yield any benefits in terms of usefulness and usability of the standards. Rather, mechanisms have to be provided that enable feedback of user experience into the standardisation process. Given the time it took e-mail users to develop specific technical requirements, it will take years before a standard reaches a reasonable level of maturity and usefulness[171].

We have already noted that a successful implementation relies on a close cooperation between users and vendors. Those joint efforts will not least result in a transfer of knowledge in both directions; users will learn about the technical nut and bolts, whereas vendors can collect information on requirements that will potentially be of extreme value for future implementations [Bier 92]. Likewise, both groups need to work together during the specification of a standard, which is again going to result in knowledge transfer, albeit to a smaller degree.

We have also seen that direct user participation in standards setting is extremely limited today. Instead, indirect participation may occur through some kind of filter, established by vendors; that is, they are used as 'proxies' by their users in the hope that identified additional requirements are actually fed into the standardisation process [Jak 96d]. Assigning this role to vendors is a result of the necessary cooperation during implementation; after all, they should be sufficiently familiar with their customers' requirements to represent them on the committees. Yet, this is also a very dangerous approach, as no appropriate control mechanisms exist to verify that the requirements have actually been filed. Thus, whilst cooperation during the implementation process is sensible and necessary, it does not guarantee that user requirements will be fed into the standardisation process.

An alternative way of dealing with functional shortcomings revealed by the case studies is very much in line with observations of users in the context of configurational systems (see [Fleck 95]): innovations are being developed in-house, without worrying too much about standards-related issues. Like the approach outlined above, however, this one may be also disastrous in the long term, as it separates requirements from standards setting, with the inevitable result of less useful and usable standards. Moreover, it bears the risk of ending up with standard-based, but 'enhanced' systems, which may be perfectly integrated into their respective

[171] This holds particularly for standards intended to be long-lived, and especially for those which address networking issues. A standard for, say, the interconnection of a peripheral device to a PC may not require such lengthy procedures (see e.g. [More 96], [OECD 96b]).

environments, but are unable to interoperate due to the incompatible, and non standard-compliant functional additions[172].

Table 7.5.1 shows the requirements likely to emerge during the individual phases of e-mail introduction and diffusion. Specific requirements will largely emerge during the integration phase, when usage of e-mail shifts from an infrastructural system to a business relevant one. Only during this late stage will companies have accumulated the knowledge and experience necessary to identify functional shortcomings.

E-mail development stages	Technical characteristics	Usage characteristics	Potential input to standardisation
Phase 0: None	none	none	possibly preliminary generic requirements
Phase 1: (Local) Introduction	local services (department level)	local use only	no additional requirements
Phase 2: Interconnection	interconnection via point-to-point gateways, (very) limited integration	primarily local use, increasingly company-wide	no additional requirements
Phase 3: Interoperability	interoperability through backbone, little integration	still primarily local use; 80 : 20 (internal : external) rule applies	some more advanced requirements possible
Phase 4: Integration	quite homogeneous system, integration into business processes	largely unknown	detailed requirements

Table 7.5.1: Characteristics of the Phases-Based Introduction Process

Thus far, most enhancements to the standardisation process that seem to be necessary do not relate to the weaknesses commonly associated with this process, such as slowness, excessive formalism, and being infested with politics. Rather, it appears that continuous user input, particularly including experiences with early implementations, is the most important thing to facilitate production of useful standards. This suggests the need for a more iterative process, as it may be found in the field of systems design.

[172] This observation alone suggests that the terms 'environment' and 'context' are in need of a redefinition. Until now, they are typically used to denote a *local* setting, in the sense of 'within an organisation'. As the need for inter-organisational communication increases, the actual environment within which implementations take place will likewise need to become inter-organisational. Ultimately, there will be only one, global 'environment'.

The picture of the typical standards development process today, as described in the respective bodies' rules and further detailed - and sometimes corrected - through the case studies is shown in Figure 7.5.1. A number of open issues emerge from this picture: for instance, it is not entirely clear who initiates a standardisation activity (apart from the formal rules), and on what grounds. The activity may be either reactive or pro-active, it may or may not be based on user requirements, or it may only be supposed to serve a vendor's purposes. Moreover, until well after the completion of a standards project, it cannot be established whether or not a standard is economically viable. Given the huge amounts of money that have to go into the development of a single standard (see e.g. [Spr 95c]) it will be disastrous if a standard fails to deliver.

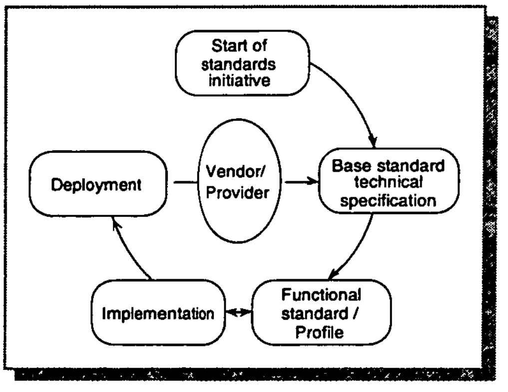

Figure 7.5.1: Development and Subsequent Deployment of a Standard

The process exhibits some more potentially severe deficiencies. For one, no dedicated requirements elicitation phase precedes the process. As it currently stands, all requirements are largely made up by committee members, to a considerable degree reflecting vendors' and service providers' interests (see chapter 6). Even worse, no formal mechanisms have been established to enable users to feed their working experience directly back into the process[173]. Thus, to actually enable meaningful involvement, modifications to the process described above will be necessary.

Considering the above deliberations, the role users should ideally assume, the comments and insights gathered through the survey, as well as the conclusions outlined above, the model for a specification development process, as depicted in Figure 7.5.2, emerges.

[173] Some feedback is possible if the originating committee continues to exist to deal with such input, for instance in the form of deficiency reports, or to develop further releases of the standard (as was the case with e.g. X.400 and X.500). Only in the latter case may upcoming new requirements be addressed.

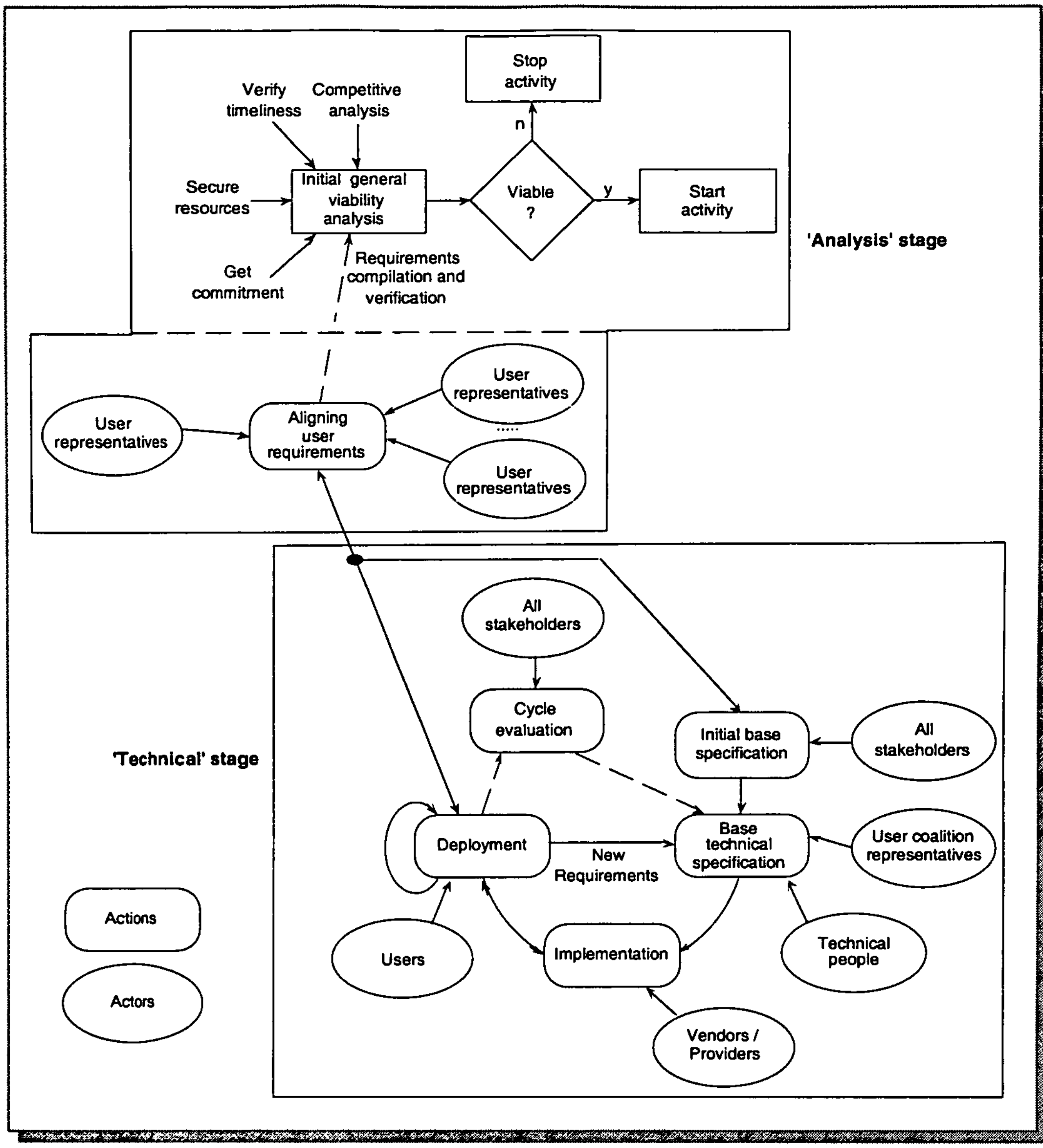

Figure 7.5.2: The Improved Cycle of Specification Development
(the Cyclic Stage Model of Standardisation, CSMS)

This model aims primarily at the support of anticipatory standards setting. Yet, in doing so it draws upon an important reactive element, i.e. cycles of user feedback. These cycles allow users to - iteratively - contribute their experiences to the process. Up to now this property has only been available in reactive standardisation, where users had the opportunity to forward their earlier experiences[174].

174 At least in theory, that is. Moreover, there was hardly a way to verify that the final system actually reflected these experiences.

This is a two-stage process, with an analysis stage preceding the technical work[175]. During the former, a first compilation and verification of initial requirements from both the technical and the business perspective is performed, the required resources are secured and, if applicable, it is ensured that a window of opportunity will be met (see also [More 96]). The model draws upon ideas from the discipline of Participatory Design, which promotes equal participation of all stakeholders in process or system design. In fact, the process will not work properly without equal and balanced participation of all interested parties, and without a common understanding of the problems and issues at hand. This holds for both phases of the model.

Ideally, commitments from all stakeholders, including vendors, service providers and users to implement and to actually use the technology, respectively, would be required at the earliest possible stage. Such commitments would help ensure that requirements will indeed be addressed and that products based on this standard will eventually be purchased. Unfortunately, given the duration of the process, the pace of technological development and the resulting level of insecurity, such strong commitments are highly unlikely. However, a common understanding, together with a certain degree of commitment and trust on the sides of both users and vendors should be feasible.

Several fundamental decisions need to be taken before the actual (technical) standards setting work can commence. First of all, it is crucial to realise the impossibility of solving all potential future problems from the outset, and accordingly not to try and specify an all-embracing standard. Recent experiences show that attempting to specify such standards are bound to fail. For example, most of the largely proactive OSI standards, based on projected user needs, and designed to include all possible options, have not been accepted in the market (see e.g. [CEU 96], [Wag 95]). Accordingly, an evolutionary approach has been adopted (very much in line with the ideas underlying the Participatory Design approach, see sect. 2.1.5.2). Work is based on a set of initial requirements, specified primarily by those who will actually use the system in the future. Subsequently, the specification can be refined based on experiences made during the deployment phase.

However, we have seen (in chapter 6) that at least the vast majority of corporate users of electronic messaging systems were not in a position to identify much more than very basic requirements on (standards for) these systems, even after having used

175 The first stage can be omitted in cases of reactive standardisation.

comparable services for a lengthy period of time. From the above discussion (in sect. 7.2) it may furthermore be concluded that this lack of more specific requirements may generally be expected for infrastructural systems. This holds especially for the field of non-technical requirements (i.e. those emerging from e.g. work processes or organisational culture), which only surface after years of usage (if at all, that is). Regarding technical requirements, only rather general and generic ones may be expected to be available from the outset[176].

Obviously, the situation will be even worse at the beginning of a proactive standards setting activity, when very little or no prior experiences at all on the side of the users must be assumed. Thus, the set of initial requirements mentioned above will, in all likelihood, be little else but a comparably sketchy wishlist. Still, despite all its shortcomings, this - inevitably rather pragmatically compiled - list represents the state-of-the-art in user requirements, and will be a far more useful starting point for any standardisation work than - probably largely unfounded - assumptions regarding future 'user needs' which are primarily defined by vendors and service providers anyway, and upon which the standards setting process is typically based today.

Having assembled the initial requirements list, its single items have to be weighed with respect to their perceived importance, potential contradictions have to be sorted out, and finally a catalogue of mandatory requirements has to be agreed upon, to serve as the basis for the subsequent technical work[177]. Furthermore, in the likely absence of well-founded, strong requirements during the early stages of the process, this catalogue will have to be 'living', i.e., requirements will be added and possibly removed as work progresses and practical experiences are gained.

Looking at the implementation of a new standard it needs to be considered if, and to what degree, it will cause changes to an already installed base. If it does, the nature an

[176] Quite surprisingly, and somewhat disconcerting, even the IETF had major problems when they had to specify requirements for the new IPng protocol. Those eventually identified were *"... presented without weighting ..."* [RFC 94e], and were criticised for being *"... too general to support a defensible choice on the grounds of technical adequacy."* (quoted in [Mont 98]) - after more than twenty years of usage and literally thousands of person-months of experience.

[177] In the case of e-mail, for instance, initial requirements could have been derived, among others, from previous experiences with the 'normal' mail delivery system, and might include 'reliable transfer', 'everyone should be reachable', 'possibility to send binary information', or 'notification of receipt'.

the extent of these changes must be evaluated carefully[178]. Again, a step-by-step approach to the introduction of changes is highly recommended, which particularly implies that only very few components of a network may be replaced at a time, and that an alignment phase has to follow each such change before another replacement may be done [Hans 96].

Moreover, a transition strategy needs to be advised. Whilst it would be desirable to have such a strategy in place prior to the technical work, it is most likely that in practice these will be developed in parallel. Indeed, as experience from the IPng standardisation process indicates, a working protocol fulfilling the initial requirements may well be standardised upon without an explicit transition strategy [Mont 98].

Ensuring backward compatibility is a closely related major issue here, as is avoiding installed-base hostility (see also sect. 6.3). Yet, as the final outcome of any major changes to a large installed base is not normally predictable, the only realistic way of approaching this problem is to use common sense, to apply a degree of pragmatism, to monitor the transition process closely, and to make sure that changes are indeed carried out gradually.

These deliberations seem to suggest that the IETF process (see [RFC 96a] and sect. 4.1.3)[179] could be a solution, as it apparently addresses all issues raised. Indeed, some of the essential characteristics discussed above can be found in the IETF process as well, including particularly the evolutionary design approach, the importance assigned to backward compatibility, and the necessary degree of pragmatism. The step-by-step approach is indeed a cornerstone of the IETF process, which aims at standardising comparably small but interoperable components, which can be combined to provide the desired functionality[180]. The installed base of the Internet alone makes backward compatibility an issue of overriding importance, and impossible to circumvent. This, too, has been realised by the IETF; even if a new version of a standard has been specified its predecessor may remain an Internet standard *"... to honor the requirements of an installed base."* [RFC 96a]. Finally, given the highly dynamic

178 Actor Network Theory (see e.g. [Call 91]) tells us that a large, well-aligned actor-network - such as e.g. the Internet, or indeed any large, global network - is almost irreversible. It can only be changed into an equally well-aligned network.

179 For an exemplary discussion of what may lie beyond the surface of the well-defined norms and rules see e.g. [Mont 98].

180 For a discussion of the risk that comes with this approach see sect. 6.1.

environment within which the IETF's standardisation work takes place, a certain level of pragmatism is essential. Examples of how this may work include the tendency to prefer producing a quick solution over doing lengthy discussion on merits and disadvantages of different proposals, and the rather relaxed attitude towards the use of external specifications (both open and proprietary)[181].

Yet, there are also some important differences. First, the IETF does not have an explicit requirements elicitation phase, or indeed any mechanism to ensure that real user requirements actually establish the basis of a standards setting activity. Not unlike the situation to be found within ISO and ITU, it is normally up to the single work group members to define the requirements they subsequently work from. Second, the IETF process requires the availability of two independent, interworking implementations as a necessary condition for a proposal to proceed on the RFC standard track. Whilst this is an important step, and one that makes the IETF process stand out from its 'competitors', I feel it stops halfway through, as this requirement aims primarily at checking the correctness of the specifications, and their interoperability, rather than exploring user requirements[182]. That is, the IETF does not care who is doing the implementations, since proof of interoperability is the only requirement. As a consequence, the implementations will be close to prototypes. In particular, they need not be employed in a real production environment. Yet, to gain experiences with, and to subsequently define real requirements derived from these experiences, it is important that the implemented system is employed in commercial working environments, and that experiences gained there will contribute to a more usable revised version of the underlying standard (as opposed to only demonstrate interoperability). Finally, IETF Work Groups are abandoned once they have achieved their goal; if a standard is in need of enhancements, a completely new group is set up.

The discussion of the issues that eventually led to the less than enthusiastic utilisation of X.400 (see sect. 6.3) has unveiled a number of problems that any new process needs to address as well. For one, inadequate first specifications led to an unfavourable perception of the service. In a standards setting process based on CSMS

[181] Obviously, there is a risk that too great a degree of this pragmatism opens a loophole for interested parties to undermine the IETF process.

[182] *"A specification from which at least two independent and interoperable implementations from different code bases have been developed, and for which sufficient successful operational experience has been obtained, may be elevated to the "Draft Standard" level. [....] "interoperable" means to be functionally equivalent or interchangeable components of the system or process in which they are used."* [RFC 96c].

the close cooperation between vendors and users during the technical work should guarantee that even initial specifications are solidly based on real world requirements (albeit potentially rather generic ones). This cooperation should also prevent excessively complex specifications. Moreover, since the process is very adaptive, potentially relevant new technical developments can easily be integrated if this is considered worthwhile. Likewise, the gradual development of specifications, and the continuing integration of emerging new requirements (and technologies) is one of the new process's most important characteristics. These issues, and some additional ones, will subsequently be discussed in more detail.

Above, I have already argued that it is more useful to strive for a reasonably fast first specification based on generic initial requirements, and to enhance it subsequently when real requirements emerge from service use, than to aim at a full-fledged specification from the outset. In parallel, efforts should be undertaken to establish confidence that a viable technology will emerge.

Based on the requirements compiled, technical committees would then attempt to develop a draft specification, which is returned to the user representatives for review and, eventually, approval. Ideally, the engineers drafting the specifications would come from both sides, vendors and users, as this would help to keep the specifications in line with the requirements available. The group of user representatives should be composed of engineers as well as non-technical people to make sure that all facets of the requirements are met. There may be several iterations, with the proviso that a balance is maintained between evaluation and development. Subsequently, the first version of the final specification can be released for implementation.

During the following deployment phase, operational experiences will be gained within a variety of user environments. Eventually, the experience accumulated will be sufficient to identify shortcomings of the specification. The resulting additional requirements identified will serve as input to a second cycle, during which the specification will be enhanced accordingly. Prior to this stage, the specification will be 'frozen', i.e. no changes may be made. This does not include dealing with 'defect reports', i.e. reports on errors or ambiguities in the original specification, which have to be acted upon immediately.

The common characteristics of the implementation process and the process of software development have been discussed in chapter 2. We have now seen that standardisation as well can be based on a model exhibiting characteristics similar to those of the spiral model of software engineering [Boehm 88][183]. The most important commonalities include the prerequisite of an initial commitment from all parties involved, the early specification of underlying requirements, and regular checkpoints. The latter are used for risk analysis in the original spiral model, whereas their equivalent in the proposed model, the 'Cycle evaluation', has a broader scope in that potentially important external developments (e.g. relevant new emerging technologies) are also taken into consideration[184]. Accordingly, this phase may well yield requirements in addition to those emerging from deployment experience (see also Figure 7.5.2).

The time of implementation of the final specification or system represents a major difference between the spiral model and the CSMS: whereas integration, acceptance test, and implementation conclude the activity according to the former, they are integral, and repetitive, elements of the latter. Likewise, the CSMS yields operational specifications (which need to be fully integrated into their respective environments) rather than prototypes. This is particularly important as many requirements will result from the particularities of implementations within the context of a specific environment. A prototype, on the other hand, is not normally integrated into its environment, and predominantly used to obtain feedback on the functional aspects of a specification, including especially the user interface.

Some particular characteristics of this process model are worth noting. For instance, it can be applied to industry consortia and official standards setting bodies alike; it does not make any assumptions regarding the process which eventually yields a specification (apart from the crucial role assigned to the user community). This is particularly important since both approaches to standards setting will be needed in the future, largely depending on the type of technology to be standardised. In some areas, such as basic telecommunications infrastructure services (as e.g. X.25 in the past, ISDN today and ATM in the near future), technical specifications need to be mature and have long-term stability to ensure that potentially large investments in such technology will not become obsolete. Here, formal standards, based on a consensus of all interested parties, will be preferred. On the other hand, in less stable areas (as e.g. PC interfaces and peripherals) agreed specifications will have to be available

[183] For a discussion of the similarities see sect. 2.1.5.1 and sect. 2.5.2.

[184] An activity which may potentially lead to additional new requirements in the light of a new technology.

quickly to establish a common basis for applications, and to avoid competing proprietary specifications. In such cases, where the expected lifespan of a specification may not be too important, less formal processes, as e.g. those typically adopted by industry consortia will be better suited. The model also allows for a consortium to do the initial specification and subsequently have a formal body to transform it into a standard once it has sufficiently matured[185].

A process based on this model would have considerable advantages over the current one, but some (minor) potential drawbacks must also be conceded. Beginning with the latter, we first note that obviously the 'first round' of the process may take longer than it does today, due to the time required for the viability analysis. Second, the process stands or falls by input from the user community. Consequently, users' attitudes towards standardisation need to be changed. They have to be convinced that active contribution to standardisation is in their interest, not just a waste of scarce resources.

Another issue relates to the need for cooperation between users, primarily during the first stage of the process. It could be argued that companies will be reluctant to publish and discuss their requirements, making them available to competitors, as they might see a danger of revealing too much of their strategic planning. However, successful work done within various consortia, for example, shows that users themselves apparently are not too worried by this issue [Upde 95a].

These problems are more than compensated for by the benefits. For one, a viability analysis preceding the technical work will help reduce the number of unsuccessful standardisation activities. As a desirable side effect, this will also free resources, both financial and human, from projects that are not likely to produce any viable output anyway, thus compensating, at least in part, for the additional resources required to develop the viability analysis.

The second major advantage relates to the mechanism provided for user feedback. As pointed out above, the model is based on two assumptions. The first postulates that requirements will emerge over time, and that it may well take them more than a decade to develop (as it did in the case of e-mail). The second one postulates that a standardisation activity is not just a matter of setting up a committee, producing a standard, and disbanding it again (as e.g. the IETF does). Some European research

[185] This approach bears some similarities to ISO JTC1's PAS procedure (see sect. 4.1.1).

programmes, most notably RACE[186] and ACTS[187], have adopted a similar, although less formal, approach. In these programmes, certain projects serve as testbeds at user sites; experiences gained from these sites are contributed to European standards bodies, typically ETSI. This approach has to some degree been borrowed from the usability domain, where 'learning-by-using' - typically through prototypes - is a popular way of identifying usability deficiencies in a software system [Lind 94b][188]. Reassessments could be done on a regular basis, thus making standards development more reliable, and easing the task of systems planning for the user community. They would ensure the start of new specification activities if and when sufficiently strong new requirements emerge. It follows that the user community must have the right to demand the specification of a new version of a standard.

Summarising the characteristics of the proposed model of a standards setting process, it can be noted that a viability analysis preceding the actual technical work should not only make standardisation more efficient, but should also reduce the number of standards, making life easier for both users and vendors. The feedback and monitor mechanisms for users will significantly contribute to standards that meet actual requirements. The price to pay is primarily constituted by the longer overall process. To compensate for this, the time allocated for the technical specification of a standard should be minimised, to enable timely first implementations.

7.6 Future Work

The conclusions reached, and the lessons potentially to be learned have been based on a survey of representatives of large e-mail user corporations and members of those standards committees in charge of messaging services. For this particular domain, I consider these conclusions as valid and well-founded. I also feel that some lessons may be applied to other services and environments with sufficiently similar characteristics; in particular, standardisation activities relating to the GII are potential beneficiaries. Considerable further work needs to be done to establish to which other environments the results of this thesis may be applied. For example, a categorisation of environments would be helpful to identify differences and similarities. Some further aspects that would benefit from future research are briefly outlined in the following.

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186 Research and Development in Advanced Communications Technologies in Europe.

187 Advanced Communications Technologies and Services.

188 Similar learning mechanisms have long been know - and studied - in other disciplines as well, see e.g. [Arrow 62].

It would be helpful if a representative study were undertaken to substantiate my findings. Whereas I do not think that too many new insights are to be gained, such a study would be most valuable in that it would add extra credibility to the findings. This study should also be broader in scope, covering SMEs as well, thus providing a basis for an in-depth comparison of the specific needs of large companies and those of SMEs as well as the different business sectors. I have only touched on these issues.

Regarding the social shaping of technology, and especially the view of user implementations as sources of innovations it would be interesting to examine the distinction between 'business relevant' and 'infrastructural' technology in more detail. Apparent differences between part of the SST literature and conclusions drawn from the survey findings gave rise to this classification. While it can certainly be shown that the 'elevation' of e-mail from a mere interpersonal communication system to a mission-critical application boosted corporate interest in, and requirements on, the service, further empirical studies are needed to determine whether or not 'infrastructural' and 'business relevant' actually establishes a valid and useful categorisation. In the same way, it would be interesting to analyse in more detail users' perception of the importance of standardisation and implementation when it comes to those services or systems that are regarded as 'business relevant'. For example, it could be speculated that a greater deal of strategic thinking can be observed for 'business relevant' technologies, which might affect the fortune of a company.

If we accept the premise that corporate perceptions regarding value and importance of ('infrastructural') technology may indeed change over time, it would also be interesting to find out what exactly causes these views to change. Possible alternatives here include the internal accumulation of experience that eventually leads to such changes, and new technological developments, but also general hype about e.g. new applications or business processes. In particular, the potential existence of common trajectories should be investigated. In this context it would also be interesting to study the diffusion process of e-mail (and similar IT systems) in more detail. The processes that have been unveiled by the case studies suggest that the popular 'critical mass' theory is ill equipped to explain the introduction and diffusion of e-mail in large, globally operating and geographically distributed corporations.

One of the cornerstones of SST - unchallenged here - is the notion that technology is shaped by its context of use. This concept suggests that little similarities between organisations exist in this respect, and that it will accordingly be next to impossible to identify more than just a handful of common, specific requirements (i.e. requirements that from more advanced usage). From the standards setter's point of view, however, it would obviously be most helpful if unified requirements were available. Accordingly, additional research to establish if, and where, such common, cross-context requirements actually exist would be extremely helpful for requirements elicitation as a vital part of the standards setting process.

The proposed new model of the standards setting process is to a great extent based on the notion that specific user requirements will not normally be available at the beginning of a standards activity (this holds particularly for anticipatory standards). As this proposal is in stark contrast to the widely held position that strong permanent user participation in standards setting is a sine-qua-non, further research into the development of user requirements will be needed to back this suggestion which probably looks somewhat strange to some. Likewise, the proposal to start with a viability analysis plus a basic first implementation, rather than to specify a very elaborate system from the outset - as it is the case today - will raise a few eyebrows.

7.7 And Finally

To finish with, brief summarising answers to the research questions underlying this thesis shall be provided.

- **Are the processes of innovation and standardisation related? If so, what is the nature of this relation?**
  They are in fact closely related; to an increasing extent implementations exploit standardised components. Moreover, the innovation process during implementation will more and more be complemented by innovations during standards setting. Likewise will the cooperation between users and vendors in part move from the site of implementation into standards committees. Finally, in the light of the advent of an eventually ubiquitous global information infrastructure which needs to integrate extremely heterogeneous IT artifacts, standards will become a sine-qua-non for future implementations.

- **Is the promotion of increased user participation a suitable means for producing useful standards in the IT domain? What else can be done to achieve this goal?**
  Yes and no. There is no doubt that user participation is crucial for the development of useful and usable standards. Users' prime functions in the

process should be the specification of requirements and the monitoring of the process to assure that these requirements will actually be met. However, because of the considerable time it takes users to develop meaningful and concrete requirements they should only be involved in a very early stage (for preliminary requirements compilation), and after first systems have been implemented and extensively used.

Due to the highly context-specific nature of user requirements, unconditional direct participation of users, each potentially contributing specific requirements, will be counter productive. Instead, a dedicated user coalition should align, and assign priorities to their stakeholders' requirements and represent them in the committees.

- **In which respect need the processes adopted by voluntary, consensus based standards setting bodies be changed to enable the production of IT standards that meet user needs?**

  The process definitely needs to be changed, in various respects. First, a viability analysis will help concentrate efforts on standards that stand a realistic chance of survival in the marketplace. Second, a common understanding of all stakeholders regarding what can and should be achieved, plus a quick first version of the specification, and its subsequent implementation, will allow users to gain experiences and to develop further-reaching requirements. These can then be fed back into the process through well-defined channels which themselves are part of this very process, and serve as the basis for a second version. This is more important than producing a fully-fledged specification from the outset which takes years to develop, and which is likely to be based on ill-defined requirements anyway.

Putting it all together, standardisation is bound to play an increasingly crucial role, not only for the emerging information infrastructures, but also in implementation processes, and as an additional source of innovations. To be able to produce usable and useful standards the standardisation processes need to be improved. All stakeholders in the process stand to benefit if they can summon up the energy required to bring standardisation processes in line with reality.

Chapter 8

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Appendix A
Questionnaires

Questionnaire User Company Representatives

Part 1: General

G1 Please provide some background information about your organization (number of staff, locations of branches/departments/subsidiaries.., etc).

G2 Please give some information on the structure and usage of messaging services in your organization (eg. which system(s) is/are being installed, how does the topology look like, number of users, number of messages/month, etc).

G3 Please provide some information about yourself, your tasks and responsibilities, and your department.

Part 2: E-Mail

E1 A little bit of history: when and how did e-mail emerge in your organization (top-down - ie following a management decision - vs bottom-up, ie. more or less isolated at different sites).

E2 Do you have an organization-wide e-mail strategy by now? If so, when, how and why has this strategy been specified, and who was in charge?

E3 What did your organization expect from taking e-mail on board (eg. more convenient internal communication, competitive advantage, less pressure from business partners)?

E4 Did you do a requirements analysis beforehand? If yes, are the results available (I would be particularly interested in specific functional requirements)?

E5 Did you (have to) do a cost/benefit analysis? If yes, are any information available?

E6 What were the initial criteria for the system of choice, and why did you select a particular system (eg. proprietary, SMTP/MIME, X.400)?

E7 Who was in charge of the introduction (eg. central IT department, local departments, third parties)?

E8 What were the major problems in introducing e-mail (eg. convince management, get funding, technical issues, ...)?

E9 What kind of user support do you provide (user training, dedicated support staff, help-desks, special manuals, ...), and who is in charge?

E10 What are the main application areas (interpersonal messaging, mail-enabled applications like eg. EDI, groupware, ...)?

E11 Which problems/drawbacks/shortcomings/flaws/.... have been identified - related to technical issues (eg. directories, security, gateways)? - related to organizational issues (eg. funding)? - related to end-user issues (eg. dissatisfaction, no-use)?

E12 Is there something like a list of essential/nice-to- have/unimportant functional requirements (eg. mandatory notification is essential, low transfer times are nice-to-have, video body parts are of no interest at all)? Again, I would be particularly interested in specific functional requirements.

E13 What will be the next steps (eg. integration of mobile users, enhance security, install uniform directory, interconnect to the Internet, ...)?

E14 Which major benefits have been identified?

E15 Are there any cost-related information available (ie. hard- and software, personnel, transmission)?

E16 Did e-mail have an impact on the organizational structure of your company?

E17 Do you have any evidence if use of e-mail has changed the way people communicate?

E18 Are there any established communication channels for your end- users to report on problems, additional requirements, make suggestions, etc?

E19 What is your overall assessment concerning the usefulness of the system?

E20 If the system has been successful, what has been the single most important contributor?

Part 3: Directory

D1 Does your organization operate a directory service? If yes, of which type (eg. proprietary, X.500)?

D2 Do you have some usage statistics available?

D3 What have been the major motivations for installing the service?

D4 Did you do a requirements analysis prior to installation?

D5 What were the major problems prior to/during installation?

D6 What are the major fields of application for the directory (eg. internal/external white/yellow pages, security, more general information system)?

D7 Which applications are the major beneficiaries of the directory (eg. e-mail, EDI, groupware)

D8 Do you plan to integrate any other data bases (eg. HR data bases)?

D9 What are the major problems identified during operation of the service (eg. integration, DIT population, interconnection, data management etc.)?

D10 What are the major functional flaws/shortcomings of the service (if any)?

D11 Again: is there something like a list of essential/nice-to- have/unimportant functional requirements?

D12 Who will be able to access your data (only internal users, business partners, public)? Why?

D13 Have you been participating in public pilots (as eg. Paradise)? Why (not)?

D14 What is your overall assessment concerning the usefulness of the directory service?

Part 4: Standardization

S1 Is your company active in user organizations (as eg. EEMA)?

S2 If yes, why, and what are the major activities?

S3 Has your organization been actively involved in standardization efforts? If yes, where (ITU, ISO, ETSI, IETF, ...)

S4 If not, why not (eg too expensive, too time consuming, don't see any real benefits...)?

S5 If yes, which department has been in charge of the standardization activities? Why?

S6 Why did/do your representatives attend standardization committee meetings (to push superior technical solutions, to promote company solutions, to represent customers' or company requirements, to gain experience and knowledge, ...)?

S7 How do you exploit the knowledge/expertise gained through participation in standardization (eg. design better products/ services, enhance usefulness of product/service for company/ customer, ...)?

S8 What are the estimated costs per representative per year?

S9 Are there any (technical) issues that you feel have not been addressed adequately by the standards committees (eg. name representation)?

S10 Are there any open (technical) questions your company would need a solution for (eg. MHS routing)?

S11 What would you consider the most appropriate way for your organization to promote standards-related issues?

S12 What would you consider as the best/most effective/most convenient way for your organization to participate in standardization work (representatives at group meetings, a dedicated user committee, ...)?

Questionnaire Committee Members

1 For how long have you been active in standardization? Where (eg. ITU, ISO)?

2 On which committees have you been active, and what have been your role(s) (eg. editor, rapporteur, member)?

3 Why did you attend the meetings in the first place (eg. boss told me to go, interested in topic, part of the job)?

4 How would you characterize your role in the process (eg. company representative, national representative, user´s advocate, promoter of technically superior solutions, ...)?

5 How would you characterize the ISO/ITU standardization process?

6 What are its major strengths and weaknesses?

7 According to your experience, what kind of organizations (ie. manufacturers, service providers, governments, users, PTTs, PNOs, research institutions) are represented in the committees?, and which are the most dominant ones (if any)?

8 How do standardization activities typically emerge (eg. based on products/services already available, based on an identified demand, others)? Can you give a typical example?

9 Who identifies the initial requirements (eg. technical people in the committee, other committees, user representatives, product specs)?

10 Are there any formal/informal mechanisms to integrate user requirements either prior to or during the standardization process, or for a new version of the documents?

11 Are there normally formal/informal cooperations with user groups? If yes, how?

12 How do you evaluate the usefulness of dedicated 'Service Definition' committees (like eg. SGI, or the old SC18, WG1)?

13 Again, according to your experience, what are the main factors influencing technical decisions taken (eg. supporters/opponents are present during discussion, reputation of supporters/opponents, purely the technical merits, solution has already been implemented somewhere, company/national/ group interests)? Please indicate their relative importance as well.

14 Are a standard's complexity, usefulness or usability of concern? If yes, what is being done about it?

15 How would you describe the respective outcome, ie. the final standard (eg. too complex, just great, should do)?

16 Do you think stronger user participation in the process might be of benefit?

17 If yes, how would you envisage getting users to participate (eg. go to meetings, set up additional 'user-committees', dedicated Service Definition groups)?

18 Which benefits would you expect from increased user participation (if any)?

19 Please identify prospective drawbacks/problems possibly resulting from increased user participation (if any).

20 Would you personally like to see a higher degree of user involvement in the process? Why (not)?

21 What improvements to the standardization process would you suggest (if any)?

Appendix B
Published Papers

Permission to include the papers in the thesis has been obtained.

Position Paper for CHI '95 Research Symposium, (May 6-7, 1995, Denver, Colorado U.S.A.)

Usability vs Standardization?

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ABSTRACT

This paper describes an ongoing research project into the relationship between usability and technical standards. While the HCI community has focused considerable attention on improving systems design processes to increase usability, the influence of other factors remains largely unnoticed. One such factor is technical standards which structure design and place constraints on designers' capacity to satisfy users' requirements. However, little progress has been made in opening up the standardization process to users. We argue that ways must be found to involve users meaningfully in this process. We illustrate our case by reference to communications standards related to electronic mail.

KEYWORDS: usability, standardization, e-mail.

MOTIVATION

Over the past ten years, much has been learnt about ways of improving the usability of IT systems. By far the greatest contribution has been the recognition of the need to raise the level of understanding between systems designers and various categories of users (e.g. corporate users, end users, administrators). However, user participation in design is not a panacea for usability problems. Elsewhere, we have argued that user participation in design is a necessary -- but not in itself sufficient -- condition for addressing usability problems; usability is an ongoing relation between users and systems arising in the context of use. We pointed to important innovation processes after systems have become operational. Systems evolve and are re-designed *in use* -- though the power of some user categories (e.g. end users) to influence such changes may often be limited [4].

The ways in which conventional approaches privilege the role of design also ignores the fact that a huge number of important decisions have already been made before designers begin their task. This includes the selection from a variety of established standards (both *de jure* and *de facto*) which, through their embodiment in components and sub-systems collectively define the technical framework within which design work must be accomplished.

This paper argues for a broader perspective that addresses the whole system life cycle -- a perspective that is becoming more relevant in the light of technological developments -- including, for example, the shift from stand-alone to distributed applications and the ever growing complexity of the IT infrastructure. Regarding the former: usability and design have typically been considered in the case of stand-alone systems. Strong and well-defined local relationships between designers and groups of users can allow exchange of information, yielding an in-depth knowledge of users' requirements and of the capabilities of hardware and software available. With the shift to distributed applications, however, the picture becomes more complex, involving ever more users and designers. Though specific designers and users may collaborate closely in developing particular applications, most people are not directly linked and have only limited knowledge of the entire distributed system. Another feature of distributed applications is the growing demand for interoperability and hence for standardized communications services. However, today's standardization processes tend to be slow and expensive, and run the risk of yielding far too complex solutions. To avoid this, and given the increasing pace of technological development, usable standards become increasingly important to prefigure (at least some aspects of) emerging technologies and thus ease the task of interoperation.

Thus, the second argument of this paper is that standards are becoming more and more important for usability -- especially in the case of distributed applications, but also because systems development will not take place from scratch but will increasingly incorporate, and be structured around, standardized components and tools. To some extent design is steadily taking on the character of mere standards implementation and component integration. Standards of lower-level communications services are already well-advanced, and standardization has increasingly become a crucial feature of higher-level services (such as e-mail), and even of IT applications. We highlight the potential for conflict between standards and usability:

standards represent conscious or implicit agreements about generic functionalities which can be divorced from the local context of use, whereas usability is only definable within the local context. A number of points follow on from this. It is clearly desirable that standards do not constrain the designer's freedom to address that local context. However, there is a tension between the goals of catering for generic functionality while maintaining flexibility to deal with local user variability. This contradiction is particularly acute in the case of distributed applications where a framework of communication standards strongly biases actual design considerations for the application.

From the point of usability, therefore, it becomes increasingly important to understand how standardization processes work and, in particular, where they fail to address users' requirements, and why. Clearly, these are matters of crucial importance to users. However, in contrast with the growing body of knowledge and techniques for involving the user in design, there is relatively little discussion, let alone experience, of user participation in standard setting processes.

LOOKING AT STANDARDIZATION PROCESSES

Standardization is influenced by an ever increasing range of players, by political, economic and administrative factors, and by the rapid pace of technological development. Thus, it is little wonder that the formal standard setting of e.g. the International Organization for Standardization (ISO) tends to be frustratingly slow, and sometimes highly ineffective.

Given the diversity of user requirements and contexts, formal standards organizations face a dilemma, between a pragmatic route of pursuing basic, 'lowest common denominator' standards which can be developed and adopted relatively cheaply/quickly and embarking upon more long-term developments of more complex or more encompassing standards [1]. International standards organizations have often pursued the latter. Though this holds out the hope of more advanced standards, in practice it frequently results in unduly complex specifications that prove extremely difficult to implement, maintain and manage. Moreover, the desire to please everyone is often reflected in attempts to reconcile diverse requirements by allowing a variety of options -- which may lead to systems which conform to the specifications, yet are unable to interoperate. Such time-consuming processes also carry the danger of producing specifications which are quickly rendered virtually obsolete through the failure to consider the latest technical developments. Even worse, slow standardization is a major obstacle to progress, as systems designers will be reluctant to adopt non-standard solutions. On the other hand, the pragmatic strategy adopted within standardization bodies such as the Internet community -- i.e. to address relatively small standards issues through rather informal working groups -- yields quick results, but may leave users unsatisfied because of its "patchwork-like" character.

E-MAIL SERVICES -- A CASE STUDY

E-mail and related services like directories and bulletin boards have been selected for an in-depth case study on the impact of standardization on usability. As e-mail is by far the most popular communication service, here at least we might expect to find a high degree of usability. However, a number of earlier studies show that these services often fail to live up to users' expectations [e.g. 2]. More recent findings [3] seem to suggest that from the corporate users' point of view major problems are primarily related to the way services are being offered by service providers rather than to flaws in the functionality as specified in the respective standards.

The present study will collect relevant requirements from a range of users, including

- corporate users, representing the organizational view,
- end users, who interact with a service either directly or indirectly through an application (e.g. EDI),
- system administrators, in charge of maintaining a service on behalf of their users,
- network managers, for the service providers.

Once these requirements have been obtained, they will be matched against the functionality described in the respective documents. The study will examine the extent to which any gaps identified can be filled through refinements and additions to existing standards. In this way, the study will provide users with a vehicle to communicate their requirements to standardization bodies in a way convenient for all parties involved. This, however, should only be seen as an initial step towards a greater degree of user participation in standardization processes. On this issue, the study will make a useful contribution to understanding what (if any) obstacles exist, and how they may be overcome.

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Future (data) communication networks – the challenge to (public) service providers

Kai Jakobs

This paper considers the challenges service providers will have to face in the near future. A discussion of what a typical corporate user is likely to experience today is followed by a brief introduction to usability issues, including a discussion of the state of relevant standardization efforts. Subsequently, advanced applications and their needs for enhanced application layer services will be outlined, which will in turn have considerable impact on the functionality required from the underlying transfer system. In particular, the need of guaranteed and negotiable QoS will be addressed. Finally, we touch on the network infrastructure which will become necessary to transport the huge volume of data likely to be produced by distributed multimedia applications.

Keywords: usability, (multimedia) applications, application layer services, transfer functionality, network infrastructure

WHAT DO WE HAVE NOW?

Distributed applications are becoming more and more demanding in terms of both bandwidth and communication functionality. With the advent of high-speed networks such as FDDI (Fibre Distributed Data Interface), DQDB (Distributed Queue Dual Bus), and particularly ATM (Asynchronous Transfer Mode), the issue of bandwidth may be reduced to a purely financial question. Unfortunately, the provision of advanced communication functionality cannot be solved that easily. This holds particularly for public service providers, who have to face the additional challenge of an ongoing liberalization of the communication market.

In the 'good old days', X.25 was virtually the only public data service available, and potential customers were offered some kind of 'take it or leave it' choice. Luckily enough, times have changed. Today, customers demand services that are sufficiently flexible and versatile to adapt to their respective applications' communication requirements.

Usability is another area to be considered, which may well turn out to be most crucial. Services provided need to be usable, that is, they must reflect real user demands. As of today, the development and provision of communication functionality are still almost exclusively technology driven; services offered tend to solely reflect the provider's priorities, like manageability rather than user friendliness. Moreover, every now and then new services completely fail to live up to users' needs, the original German Videotex service Bildschirmtext being a disastrous example.

Thus, usable advanced application-oriented data communication services (to be provided by the application layer), rather than simple end-to-end connectivity, will have to be made available. Moreover, the provision of interactive services like video telephony and, particularly, videoconferencing will be of great importance. Primarily, the latter will pose considerable extra requirements on both the underlying transfer service (which combines functionalities of the OSI transport and network layers) and the network infrastructure (e.g. ATM, ISDN, the Internet).

Accordingly, service providers will have to look carefully at three distinct areas:

- *usability and usage issues*, e.g. user-friendly application service interworking;
- *application-oriented services*, e.g. multimedia mail and a global directory; and
- *transfer-oriented services*, including, for instance, support of real-time communication and guaranteed (re)negotiable Quality of Service (QoS).

This paper is not going to look at issues and problems related to applications or their user interfaces, as these

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are clearly outside the scope of a service provider. The term *service provider* denotes an entity offering application layer services to its subscribers. Throughout this paper, I will assume that this entity is also responsible for the underlying transfer service.

The remainder of the paper is organized as follows. The next section presents the problems a (fictitious) organization has to face if standard electronic communication systems are to be used. This is followed by a brief discussion of usability issues related to communication services. The paper then looks at distributed applications and the application layer services they will have to use. Subsequently, the functionality required of the underlying communication-oriented services is discussed. Sufficient functionality at this level will be crucial for both the effective utilization of the high bandwidth available and the support of application requirements in an efficient way. Network infrastructure issues are briefly considered, and finally, some concluding remarks are given.

MOTIVATION – A FICTITIOUS CASE STUDY

The hypothetical experiences of a fictitious company, wishing to back their various new and envisaged applications with adequate communication services (i.e. application layer and transfer layer services) are outlined in this section.

A large multinational company is reviewing its communication system. They find it inadequate for their envisaged future applications, and decide to take on board advanced multimedia communication services. They also have a reasonably accurate specification of their communication needs, which should *inter alia* accommodate CSCW[1] (Computer Supported Cooperative Work) applications and EDI[2] (Electronic Data Interchange) for day-to-day work. They also wish to use standardized systems rather than implement proprietary services; they need to communicate with business partners on the Internet, which requires interoperation at application service level. Finally, they would like to offer a highly suitable and acceptable electronic working environment to their employees.

Obviously, their first task will be to determine what is available off-the-shelf from international service providers. Some disappointment can be predicted. Why? The first thing to realize is the gap between their requirements and the services actually available. As of today, X.400[3] in the public sector and MIME[4] (Multipurpose Multimedia Mail Extension) on the Internet are the only application services actually offered on a sufficiently broad scale. However, none of the public X.400 systems supports the full range of capabilities as specified in the respective recommendations. This particularly holds for multimedia capabilities and security services. Moreover, as no global directory service is available, the usability of email is severely reduced (imagine the telephone network without phonebooks and inquiries).

CSCW applications typically integrate interactive video with data services. Therefore, very different communication patterns need to be supported by the underlying transfer system. For instance, a videoconference may well tolerate some transmission errors and even packet losses, but is extremely demanding in terms of bandwidth. In contrast, an electronic message or a file transfer will consume little bandwidth, but cannot tolerate any transmission errors.

This leads us to the major problem related to the underlying transfer system: adequate support of a re-negotiable Quality of Service (QoS).

The above (incomplete) list of shortcomings and open issues in the world of networking should give at least a rough idea of what remains to be done. Bridging the gap between requirements and services offered is next to impossible at the moment (unless you decide to establish a dedicated proprietary network). As far as application layer services are concerned, the political obstacles are bound to be overcome soon. Unfortunately, this does not hold for the technical issues. Things look similar at the transfer level. Considerable research has been going in this area, although little visible progress has been achieved in standardization, let alone widespread implementation.

On the other hand, X.400 services, as they are offered today, can well be used, and are being used, for EDI applications. However, having said that, it must be noted that X.400 is used solely as a transport medium for EDI messages, that is, there are no public X.400 implementations supporting EDI messages through dedicated body parts. Transfer services (or rather transport services), as they are implemented today, can be used for a huge range of applications[5,6], though in many cases they prove to be very inefficient. Finally, the network infrastructure enabling sophisticated transfer services and high-end multimedia applications (e.g. by simply offering sufficient bandwidth), is far from being available at a broad scale.

Moving top-down, the following sections consider the single problems encountered by our fictitious company in greater detail.

SERVICE USABILITY

This section briefly outlines issues related to the usability of communication services. I will point out the importance of acceptance and usability as major prerequisites for successful communication services, and will address some standardization efforts in this area.

ISO, the International Organization for Standardization, defines usability as follows[7]:

- *Usability*
  The effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments.
  - *Effectiveness*
    The accuracy and completeness with which specified users can achieve specified goals in particular environments.

— *Efficiency*
  The resources expended in relation to the accuracy and completeness of goals achieved.
— *Satisfaction*
  The comfort and acceptability of the work system to its users and other people affected by its use.

Given this definition, usability appears to be primarily related to the user interface. In fact, it is very often seen this way. However, given that the term 'user' in the definition is in no way limited to 'human end-user', and given that even the most sophisticated application cannot overcome inadequate functionality offered by an underlying communication service, this view appears to be too limited. Accordingly, communication services need to be considered from the usability point of view as well, even if they are completely hidden from the user. With this in mind, usability has to be a major concern of any service provider. Strangely enough, this is not the case. Standardization work in this field, for instance, is primarily focusing on topics like the ergonomy of user terminals.

There is, however, one notable exception. Common functional specifications (CFS)[8] are being produced within the framework of the RACE (Research and Development in Advanced Communications Technologies in Europe) programme. They address virtually all issues of integrated broadband communications (IBC; such systems are supposed to integrate the three previously separated areas of telecommunications, information technology and CATV). Strictly speaking, these specifications are not binding standards; some of them are not very readable at all, and despite being in part mandatory for European IT manufacturers, given their current form they are unlikely to be actually taken on board by manufacturers. However, a considerable number of CFSs have been submitted to international standardization bodies, and have already had some impact on standardization. This holds particularly for those related to usability.

Although far from being complete, the P-series CFSs[9] are the most elaborate documents about usability issues and communication services. Thus, there is some hope that standardization in this area will progress after all. In particular, these CFSs deal with "the consideration of how (and to what extent) customers may wish to use potential capabilities, and the determination of what design characteristics are required to improve their usability". That is, "..., an IBC system is one which has been derived from a design process which begins with analysis of the needs of the user"[8].

Figure 1 shows the identified set of usage issues, omitting those related to manageability and to network provider costs (for detailed explanations see Reference 9).

From the service provider's point of view, the specification on Generic Usability Attributes, identifying common usability requirements valid for every IBC service, and the specification series on Usability Requirements for IBC Services should be of paramount importance. The latter identified usability requirements for different services, including:

- conferencing,
- distribution,
- retrieval,
- messaging, and
- service integration.

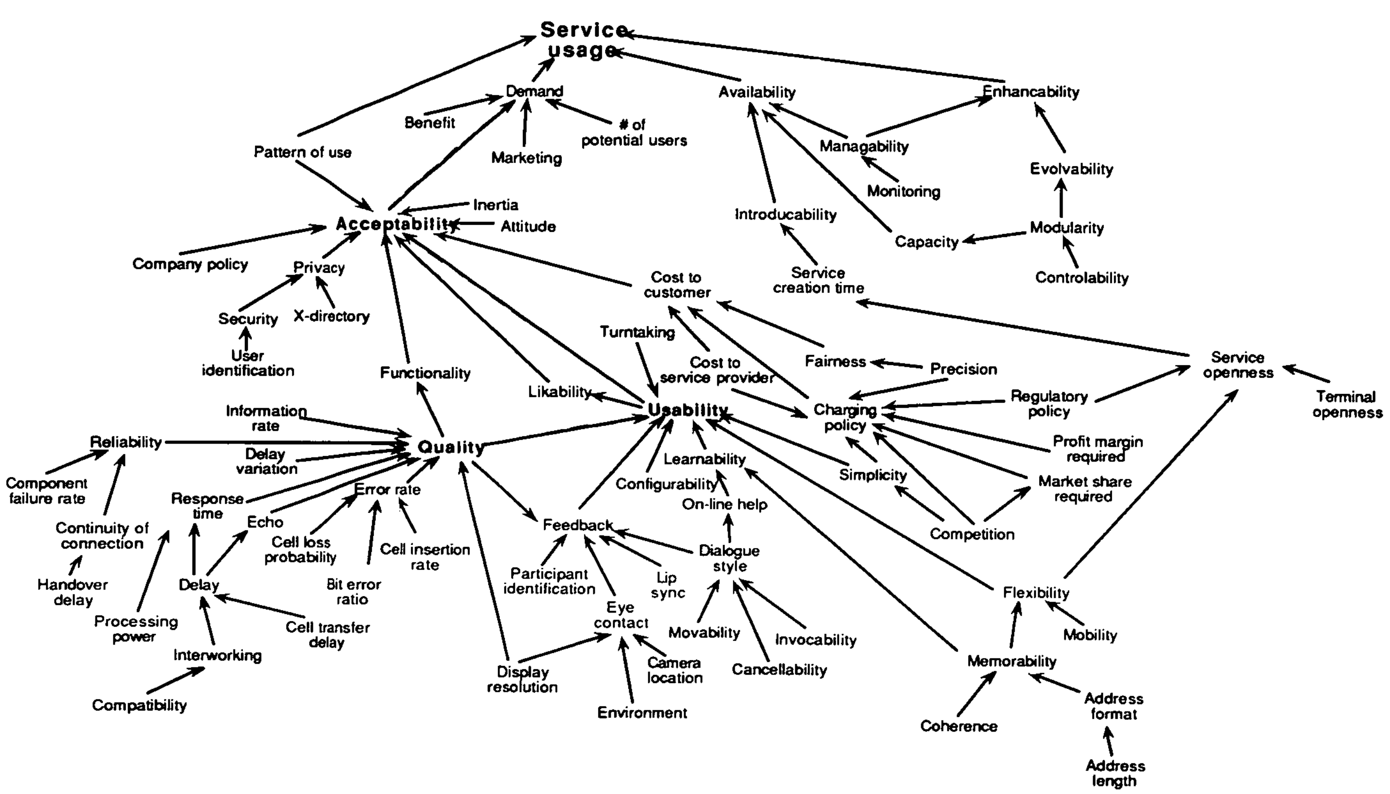

Figure 1 Set of identified usage issues[9]

Unfortunately, these specifications are still in a premature state. Once completed, however, they may establish a useful guideline on the functionality to be offered by various application layer services. The requirements for messaging are listed below as a brief example:

- User action required for determination of the correct address(es) should be minimized (Addressing).
- Information should be provided on the costs of the task prior to connection set-up (Cost feedback).
- Default configurations should be available for a certain task (Defaults).
- It should be possible to immediately delete unwanted messages or to refuse their receipt (Filtering).
- Terminating the process of messages sent mistakenly should be possible (Message abort).
- Both sender and receiver should be informed about the status of a message (Message confirmation).
- The sender should be enabled to provide information on the order of messages (Ordering).
- The user should be able to specify the priority of a certain message (Priority).
- Information should be provided to the user in case of a communication failure (Reliability).
- It should be possible to specify access rights to messages (Security/Privacy).
- Information about resources available at the sink should be obtainable prior to connection set-up (Service resource availability).

These requirements are in fact minimal and very basic. They only cover a small part of the overall messaging functionality desired. Moreover, no distinction is being made between services provided locally, such as filtering and ordering, and those provided by the actual communication service. However, even these very basic necessities are not fully met by today's messaging services; addressing and security designating two examples of obvious shortcomings. These two particular problems could be solved by a public directory service, which provides for both user-friendly naming facilities and a public key cryptosystem enabling authentication and electronic signatures.

APPLICATIONS AND APPLICATION LAYER SERVICES

This section first looks at the broad range of advanced distributed applications, some of which our fictitious company already operates or is planning to do so*. This is followed by a discussion of the application layer services required by these applications. Subsequently, the importance of a global directory service and the significance of adequate provisions for service interworking are addressed.

*Actually, these applications are used today by RACE Application Pilot projects.

Applications

Surveys have been conducted within the RACE framework aiming to identify the range of distributed applications currently being used within the projects[10]. These results should not be considered as a definitive compilation of what will be needed in future, but they do give a good impression of what might be required. After all, these pilots are supposed to precede real-world applications. *Table 1* shows the applications and the different business and market sectors.

Application layer services required

An analysis of these applications, plus results from other surveys[11], identify the core application layer services required (*Table 2*). Electronic messaging, file transfer and access to databases were declared as essential almost unanimously. Moreover, requirements for multimedia capabilities have been identified for all services. Sticking to internationally standardized services, this means MHS, FTAM (File Transfer, Access and Management) and RDA (Remote Database Access), respectively. Today's situation with respect to the availability of these services from public providers may be described as follows:

- *MHS:* this is basically the only service offered by public service providers. Some 40 implementations are commercially available, and all West-European PTTs (or equivalent organizations) offer this service. The well-known deficiencies include:
  - lacking support of multimedia,
  - very limited support of group communication (note that in this context the term *group communication* is used in its asynchronous sense, referring to distribution lists – with possibly dynamically changing membership – and blackboards), and
  - no or only rudimentary availability of a directory service.
- *FTAM*[12]: works on a bilateral client-server basis (as opposed to MHS's store-and-forward technique). This makes it less interesting for service providers, unless they intend to provide a file repository as well. FTAM will continue to be used bilaterally, thus its users can live with using public X.25 or ISDN networks for data transport, provided that the required upper layer protocols are implemented locally at their respective sites (in principle, this holds for email services as well. However, as MHS has adopted a store-and-forward approach, there is a need for some sort of service provider).
- *RDA:* offering this service implies the provision of a database as well. Therefore, the situation for RDA[13] is very much the same as for FTAM.
- *Directory service (DS):* although the survey data suggest that a directory is of no major importance, it is likely that X.500[14] will become an extremely

Table 1 Range of RACE application pilots

Manufacturing	**Culture/Entertainment**
Distributed manufacturing design	Access to pay-per-view
Interconnected manufacturing	Consult/navigate in database
Logistics	
Training on the job	**People with Special Needs**
Home working, portable work, telecommuting	Remote response to emergencies
Collaborative design of PCBs	Remote advice and guidance
Collaborative CAD/CAM design conference	Remote information access/provision
Remote monitoring of manufacturing process	Remote access to counselling
Multimedia messaging	Remote provision of therapy
Access to updated precise technical information	Remote training (with visual representation)
Constitution of a database	Remote care on demand – interactive
	Remote care on demand – noninteractive
Banking/Insurance	Remote conversation (social interaction)
Hotel reservation, check-in/out, pre-authorization request	
Transfers, consulting of accounts	**Health Care**
Remote insurance case handling	Transmission of images and data for diagnosis
Insurance case transmission	Transmission of patient folder
	Remote consultation
Transport	Constitution/consultation of a database
Remote consultation of database	Interpersonal communication
Remote update of database	Remote constitution of an image data base
Remote access to expertise	Remote consultation of a doctor
Remote consultation of tutorial video	Remote expert consultation to establish a diagnosis on an image
Provision of remote (shore-to-ship) expert	Remote expert consultation for medical technology transfer
	Transmission of images for medical evaluation
Publishing	Transmission of moving images for decision making
Remote access to image database	Transmission of images for technical evaluation
Remote typesetting	Transmission of images for medical evaluation
Remote including of pictures	

important service in the near future. Some PTTs already provide rudimentary X.500 or compatible services, and it may be expected that other providers will soon follow.

In addition to these pure data services, interactive services are crucial for culture/entertainment, health care and, particularly, for applications assisting people with special needs. Today, few such services are offered, and public networks are not particularly suited to handle the volume of data produced by interactive point-to-point video services, let alone point-to-multipoint. This may, however, change when (if?) Broadband-ISDN (B-ISDN) becomes widely available. This, in turn, depends upon the service providers' willingness and ability to launch this service, and perhaps even on actual user demand for it. Moreover, as most applications utilize both data communication and interactive services, the requirements on the underlying transfer network become a crucial issue.

Global directory service

No doubt the telephone network, without white or yellow pages and without directory inquiries, would be far less useful. At the moment, there is nothing available that compares to a global directory for email users, which is something not really understandable. This holds all the more since a directory would be useful not only as an information base for communication service users, but for the provider's management tasks as well. A management information base (MIB), for instance, could well be integrated with the directory information tree (DIT). Message routing, accounting and configuration management, for instance, would directly benefit from such an information repository. Moreover, the DS can be used to support group communication by managing distributed lists beyond those administered by X.400.

Recent surveys[15, 16] show that most large corporate users of electronic communication services express an urgent need for a global, standardized directory service. With no standardized service being available, they are running (proprietary) directories for internal use.

With all these benefits in mind, the reluctance of the PTTS to install an X.500 service is hardly understandable, even despite the enormous complexity of the service itself, and the immense task of setting up and maintaining such a service. In fact, I consider the non-existence of a global directory service as one of the main obstacles to the wide acceptance of data communication services in general, and of MHS in particular. Thus, the availability of a directory service would probably push the level of MHS usage as well. On the other hand, although a directory could potentially contribute a good

Table 2 Summary of required application layer services

Environment	*Services*
Manufacturing	email, DB access
Banking/insurance	email, DB access, file transfer
Transport	email, DB access, file transfer
Publishing	email, DB access, file transfer
People with special needs	email, DB access
Health care	email, DB access, file transfer, directory service
Culture/entertainment	DB access, file transfer

deal to enhanced user-friendliness, it still has its drawbacks, including:

- *extreme complexity:* functionality of the directory has drastically increased over the years (as has the sheer number of pages of the X.500 recommendation series), making it something that is exceedingly hard to implement. Moreover, due to this complexity, conformance testing has become almost impossible. You may want to ask the slightly provocative question of whether the directory is in danger of suffering the same fate as ODA[17] (Office Document Architecture, a standard for document layout description).
- *lack of user-friendliness:* although the service, once in place, would significantly contribute to user-friendliness, it is far from being perfect. Directory names, for one, cannot always be guessed easily (they should be). Names are strictly hierarchical (which is not a bad thing *per se*), but unfortunately, no global rules are available on how this hierarchy should look. Different hierarchies in different domains will make the user's task of finding information more troublesome.

In addition, there is a need to find a migration path from existing non-X.500 information bases, whilst ensuring strict privacy of data where it is required. Companies, for instance, will be very reluctant to integrate their internal data with a public directory service unless they can be absolutely sure that no misuse will be possible, and that all information will be completely under their control. Some additional work on these matters will be required here.

Service interworking

A problem most email users are familiar with is to get a message from X.400 to SMTP[18] (Simple Message Transfer Protocol, the protocol providing the Internet's email service) or *vice versa*. Although X.400–SMTP interworking can easily be achieved through dedicated gateways[19], serious addressing and reachability problems still are likely to frequently occur. This is primarily due to the unwillingness of service providers to cooperate, and/or the absence of a global directory.

MIME adds multimedia capabilities to SMTP whilst retaining backward compatibility, thus introducing new interworking problems due to its multimedia properties. The different X.400/MIME body parts need to be mapped while preserving the respective semantics. This cannot be done by gateways unless body parts and coding of MIME and X.400 are sufficiently similar. An extremely simple, yet efficient solution to this problem, by introducing an additional body part holding the necessary structure information, has been proposed[20]. This approach would even enable semantic loss-free conversion of hypermedia messages. Because of its simplicity and standard compatibility, it can help to overcome multimedia mail interworking problems. A gateway based on a similar approach is currently being built under the auspices of the German Research Network[21].

Even if all the technical issues were overcome, there would still be 'political' problems. That is, identical services, offered by different providers, do not necessarily interoperate. Obviously, this is a nuisance for every user. The best known example of this kind of problem is X.400 domain interconnection. Two different variations occur:

- *ADMD–ADMD:* this refers to the technical interworking of national X.400 services. Despite the fact that these services should be in line with the ITU-T (International Telecommunication Union – Telecommunication Standardization Sector) recommendations, full interconnection has not yet been achieved. However, the interconnection matrix has considerably been expanding. It may be expected that full interconnection will be achieved soon.
- *PrMD–PrMD:* there still are some constraints on direct PrMD–PrMD interconnection. That is, communication between users located on two different PrMDs has to be routed through an interconnecting ADMD. This is a major issue, particularly for large enterprises running their own PrMDs in different countries. Associated problems include financing and, more severe, security. Not least because of protests from such users, the 1993 edition of X.400 provides for more convenient options for PrMD interconnection.

TRANSFER SERVICE

This section addresses the functionality to be provided by the transfer layer to adequately support the types of applications described above. In particular, the task of providing re-negotiable Quality of Service (QoS) is discussed.

The average end user will hardly ever have direct access to this level, which is very much concerned with transmitting packets over the network (the transfer service integrates functionalities of the classical transport and network layers). However, this functionality has a significant, yet often ignored impact on the quality, usability and acceptability of the actual application layer service, and thus of the application. Response times, for instance, may increase dramatically in case of inefficient protocols over unreliable transmission links, causing many packet losses and thus high transmission delays. Therefore, when discussing what has to be provided by a communication system, it is crucial to also look very carefully at the capabilities of this service.

An application may well employ several different application layer services. A CSCW application, for example, will transmit messages via an electronic messaging service, retrieve data through a database access service (and may as well update this data base), and send or receive files through a file transfer service.

Such applications pose considerable requirements on the transfer system.

Sending messages to other group members, or running a videoconference, would benefit from an underlying multicast service. It has little requirements in terms of transmission delay, as message delivery within minutes is usually acceptable. As for information retrieval, things look quite different; response times in the range of minutes are clearly unacceptable; on the other hand, no multicast functionality is required. Both services, however, require full data integrity, that is, transmission errors or lost packets cannot be tolerated. Things are again different for the videoconference: interactive services only work satisfactory if transmission delay does not exceed the range of some milliseconds, and if jitter can be minimized. As all applications with their different requirements will work over the same network, the transfer layer will have to be sufficiently rich in functionality and extremely versatile. This holds particularly for the provision of multicast mechanisms and a possibly dynamically changing Quality of Service (QoS). That is, to make distributed multimedia applications acceptable to users, it will inevitably be necessary to enhance the functionality of the underlying transfer system. *Table 3* illustrates some of the most relevant QoS requirements, subdivided into functional and performance parameters[22]:

- *Performance parameters:* this includes, for instance, throughput, delay, jitter, bandwidth, connection set-up time, acceptable error rate and response time.
- *Functional QoS parameters:* this may include resource reservation, data flow synchronization, security aspects and QoS-based message routing. Furthermore, mechanisms will have to be available to monitor the actual QoS and to react to degradations. As of today, this is exactly what standard protocols cannot achieve.

Whereas the handling of performance parameters is accomplished by today's protocols, things look very different for the functional parameters. Therefore, these will be considered in further detail.

Table 3 QoS requirements

Functional parameters	*Performance parameters*
• compulsory QoS	• jitter limitation
• threshold QoS	• delay limitation
— re-negotiable	• connection setup time
— adaptive	• response time
• best effort QoS	• throughput guarantee
• maximal QoS	• acceptable error rate
• QoS monitoring	(bit/packet level)
• security mechanisms	• tolerable number of
• resource reservation	consecutive packet losses
• multipeer connections	• max/min TPDU size
(0, 1-, k-, all-reliable)	• ...
• selectable ACK- strategy	
• intra/inter media	
• synchronization	
• multi-destination routing	
• interworking capability	
• ...	

You may think of different ways in which dynamical QoS can be managed[23]:

- *best effort:* the strategy currently used by today's OSI protocols. The transfer system tries its best to provide the requested QoS. However, no guarantee is given that these parameters can and will actually be maintained. Moreover, the user is not notified if certain values have to be degraded. This approach proves unsuitable for a wide range of applications, mainly because no action can be taken by the user.
- *compulsory values:* in case of compulsory QoS values, the service provider monitors these parameters and aborts the connection if the requested value can no longer be achieved.
- *guaranteed values:* upon acceptance of the requested values, the service provider must provide for these values. Resource reservation is based on guaranteed QoS values.
- *threshold values:* with threshold values, the service provider monitors the connection and informs the user(s) if the negotiated value can no longer be achieved. The user(s) can then decide whether to accept a lower quality or release the connection.
- *maximal values:* specifying a maximal QoS value may be useful if the service provider can offer better values than requested for certain parameters, which on the other hand can interfere with other values. That is, even if the service provider were capable of supporting better values than requested, he is not allowed to do so. This may, for instance, be desirable for cost reasons.

Combinations of strategies are also possible, such as maximal values plus threshold values. In any case, the transfer system has to handle the possibility different and conflicting QoS requests that stem from a single application.

Dissemination of identical information from one sender to a possibly large number of recipients is a major characteristic of a broad range of applications (updating a distributed database, use of email distribution lists, etc.). Therefore, a number of functional parameters relate to the support of multipoint communication. This includes support of 0-, 1-, k- and/or all-reliable multipeer connections[22], a choice between different acknowledgement strategies, and provision of suitable multi-destination routing mechanisms. Some of the consequences are:

- To efficiently address a group of recipients, logical group addresses have to be provided. This includes mechanisms for management of group membership.
- To prevent a network from being loaded with packets of identical contents, yet different destination addresses, the communication system will have to provide multi-destination routing algorithms.
- To assure the sender that every recipient has actually received the information (if required), dedicated acknowledgement strategies are needed. Such strategies differ considerably from those

employed in unicast communication: just waiting for the ack of every recipient may soon cause intolerable delays.

Figure 2 show the relations and interdependencies between the major overall contributors to a transfer system's QoS. For a detailed discussion see Reference 9.

ATM signalling will enable the implementation of enhanced QoS mechanisms. However, the interoperation of transfer protocols and ATM signalling and AALs, respectively, will remain a crucial issue. It seems that public service providers tend to ignore this fact, arguing that almost all transfer functionality is already provided by ATM protocols. However, internetworking will remain a major task, as there is nothing like a homogeneous ATM world, and probably there never will be. Therefore, problems like end-to-end flow control across heterogeneous networks, and global, non-ambiguous addressing cannot be solved through ATM alone.

Failing to provide the QoS functionality outlined above will have a considerable impact on the usability of the transfer service. Any application layer service will suffer accordingly, and its likability will decrease rapidly. For the service provider, this may lead to a decreasing number of customers, and to decreasing revenues.

NETWORK INFRASTRUCTURE

The RACE PALACE project (Provisioning and Liaison for RACE Advanced Communications)[24] has produced a survey of the requirements of the RACE Application Pilots on a network infrastructure, focusing on bandwidth requirements. *Figure 3* shows the classification used.

Given the broad range of applications covered within RACE, this data may roughly be considered as representative. The survey focused on aspects like required bandwidth and type of network used, rather than communication protocols or QoS issues.

PSTNs (Public Switched Telephone Networks) and public packet switched data networks like X.25 are available in every (European) country. Narrowband-ISDN are individually switched 64 kbit/s channels. N-ISDN is available throughout Western Europe, though not necessarily in all regions of all countries. Moreover, international ISDN links still tend to cause problems every now and then. The term N*64 kbit/s is used to identify higher rates, typically 2048 kbit/s. This comprises both switched (i.e. 'bandwidth-on-demand') and fixed rate links. Finally, broadband-ISDN (B-ISDN) refers to ATM-based networks, with transmission rates exceeding 100 Mbit/s.

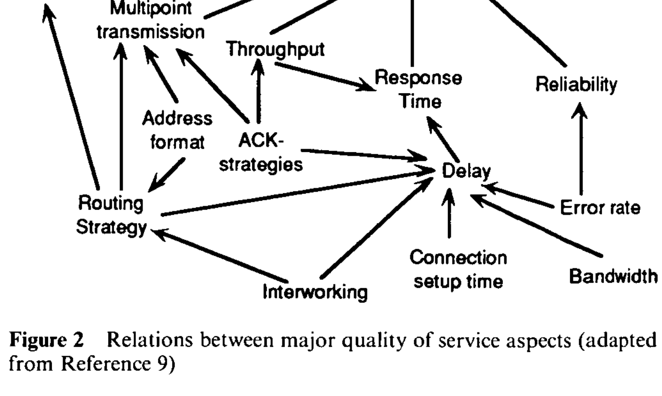

Figure 2 Relations between major quality of service aspects (adapted from Reference 9)

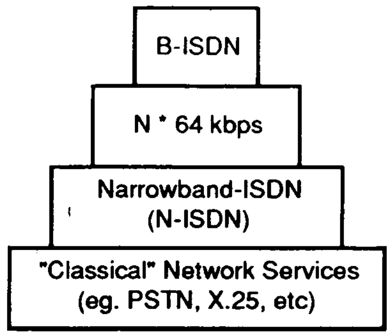

Figure 3 Network infrastructure requirement classification[24]

Applications are definitely becoming demanding in terms of bandwidth for wide-area communication. The PALACE survey shows that 62% of the applications covered use at least 2 Mbit/s links, i.e. 32 channels at 64 kbit/s. It may be assumed that requirements would be higher if bandwidth were available at a reasonable cost. This assumption is backed by the fact that (private) LANs/MANs like FDDI, DQDB and CATV networks, providing 100, 155 and 12 (reverse channel) Mbit/s, respectively, at low cost are utilized considerably as well.

WHAT WILL WE GET?

By now you will have noticed that facts and views presented in this paper were pretty much influenced by the work done within the RACE context. Although the outcome of this programme will definitely not offer the ultimate answer to communication problems, it seems fairly legitimate to state that it has contributed greatly to a more realistic vision of the necessary capabilities of the next generation communication networks. On the other hand, it remains an open question if major vendors and service providers will adopt such Euro-centred developments.

I would like to stress the importance of considering usability and usage issues prior to system design and implementation. Up to now, this seems to be something virtually unknown to communication service designers. Consider the non-uptake of the directory service, which, after all, is supposed to enhance user friendliness of a communication service. I am convinced that a user-oriented, simpler, less sophisticated, and therefore usable service (in terms of both implementation and actual use) will receive a very warm welcome from the user community.

On the other hand, it seems questionable as to whether the extensive use of buzzwords like 'multimedia', 'Broadband-ISDN' or 'ATM' draws the right picture[25]. Although it cannot be questioned that multimedia applications over B-ISDN will be in place at some time, I am absolutely unconvinced that this will happen in the next couple of years. Every now and then I suspect that these systems are being installed just because it is technically feasible, not because someone really wants them or needs them.

Considerable efforts are going into various aspects of a future communication service at the moment. This does not fortunately include usability and likeability, as well as enhanced application layer services, new sophisticated transfer mechanisms, and a new network infrastructure. The one thing that still seems to be missing is an overall approach, integrating the various efforts.

Anyway, technology will be there, and not too far from now we will know if there will also be someone willing to use it and to pay for it.

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IN and beyond: two approaches to the evolution of INs

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In the context of intelligent networks (IN), public network operators (PNO) in Europe are facing the challenges of future telecommunications through EURESCOM (European Institute for Research and Strategic Studies in Telecommunications) in a number of important research projects. This paper presents some of the results worked out by EURESCOM projects P230, 'Pan-European IN architecture', and P103, 'Evolution of the IN'. Both projects are looking at INs but from different time scales and viewpoints. The first is studying short-term development, enhancing the capabilities described in the ITU-T CS 1 architecture, with the aim of easing the provision of pan-European services through cooperative interworking between operator platforms. The second project is enlarging this view, facing the definition of an architecture for future information networks based on distributed computing and broadband transport networks. The paper overviews the approaches considered in both projects, and shows how they push the evolution of current INs towards distributed IN and software architectures which incorporate the benefits of new concepts emerging in open distributed processing (ODP) and software methodologies, e.g. object orientation..

Keywords: intelligent network, Capability Set 1, object orientation, service Interworking, software architecture

Current development of IN

The initial deployment of IN architectures has been characterized by the lack of standards, however, the work done by Bellcore in the mid-1980s[1] paved the way for the type of architecture that is widely implemented in telecom networks today. The main characteristic of these initial platforms is the adoption of the functional architecture paradigm as an approach to the development of an intelligent structured network. Under this paradigm, the ITU started the definition of the IN Capability Sets[2] in 1989, as a number of incremental phases towards a standardized architecture, that will eventually lead to the definition of the LTA (Long Term Architecture), a service architecture for future transport networks without the restrictions of today's implementations.

In parallel to the work undertaken in the short-to-medium term, other initiatives are looking at the long-term development of the IN architecture. RACE Open Service Architecture (ROSA)[3] in Europe andthe Information Networking Architecture (INA)[4] in North America have started to work on service architectures concerned with the need to overcome the shortcoming of early platforms to meet the increasing demands of operators, service providers and customers, and to cope with the complexity of future service applications. These initiatives gave rise to the definition of information networks and software architectures, as the infrastructure to support these new concepts. Today this trend is, to a great extent, focused on the work carried out in the definition of the Telecommunication Information Networking Architecture (TINA)[5], a service architecture that integrates IN and TMN[6] applications, and which is intended to be deployed on top of any type of transport network.

Trends in service architecture

The intelligent network, manifesting the addition of software platforms into networks, is a concept that is already demonstrating its potential as a driving force to change the shape of future generations of telecom networks. The success of INs in early implementations has been due to the ability to accommodate its principles in the existing switching infrastructure. However, what has been seen in the initial deployment of services isonly the tip of the iceberg. The full benefits behind the IN concept are still waiting for new architectural concepts and methodologies.

The trends and drivers in architectures include: ODP[9]

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INTRODUCING ELECTRONIC MAIL IN LARGE ORGANIZATIONS - LESSONS LEARNED FROM CASE STUDIES

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ABSTRACT

The paper presents some of the lessons learned from a number of case studies conducted in order to evaluate usefulness of electronic mail services in large international organizations. The introduction strategies employed are outlined and discussed. Subsequently, we will describe the steps taken to keep in touch with the end-users, and briefly discuss the possible impact e-mail may have on organizational structures.

INTRODUCTION

Electronic Mail has made its way into the offices of an increasing number of organizations. Recent studies on this subject (Bagshaw and Lockwood, 1994), (Jakobs and Lenssen, 1994) suggest that once it has been introduced at an organization-wide level e-mail yields considerable advantages over 'traditional' communication media such as letter, telex, fax, and phone. Major improvements identified include savings of time and money, process simplification, and enhanced cooperation.

Despite these significant advantages, however, companies have been left with a number of problems to struggle with. These include technical issues like integration of heterogeneous systems already in place at different sites (the so-called 'legacy' systems), functional shortcomings of services provided, as well as problems related to the introduction of the new technology to staff, and to react to upcoming new requirements. Strange enough, very little has been published by now that might be used as guidelines how to address the latter tasks. The paper will try and improve this situation.

We will report the results of a number of case studies (twenty-four in total) on the usefulness of electronic mail services in large, international organizations from very different business sectors (including, but not limited to finance, chemistry, aviation, and oil). We will throw light at these issues mainly form the corporate user's side, but will also consider issues related to the actual (human) end-user.

The remainder of the paper will be organized as follows: We will first have a closer look at the approaches adopted by the different organizations how to introduce e-mail. This will yield guidelines for prospective newcomers, ie. other organizations considering to adopt e-mail services. Finally, we will discuss how user requirements are being considered.

INTRODUCING E-MAIL IN AN ORGANIZATION - THE STRATEGIES

For almost all organizations analyzed the era of electronic mail dawned sometime between the late seventies and the mid-eighties. Given this time frame, it is hardly astonishing that the first generation of e-mail systems was almost exclusively mainframe-based.

Throughout this chapter we will first outline the introduction 'strategies' adopted by the organizations we have looked at. This will be followed by a discussion of the problems and issues related to the typical move from mainframes to LANs at the different sites, including those encountered during establishment of the interconnecting backbone.

The Initial Phase
Broadly speaking, you can distinguish between two different general types of introduction 'strategies' to which we will refer to as 'bottom-up' and 'top-down', respectively. There are, however, different hybrid approaches as well.

This section will categorize the different strategies identified, and discuss their respective pros and cons. In doing so, we will have to link theses strategies to the respective 'history' of messaging, that is, to the situation that had emerged before a corporate strategy took over. It will turn out that in a vast majority of cases a real strategy was implemented only at a rather late stage (which must not necessarily be a bad thing, though).

From the studies undertaken it has come very clear that large, international enterprises do not normally make overall strategic decisions concerning IT technology in general, and messaging services in particular, at the very beginning of this technology penetrating the company. In fact, this would be next to impossible, as the vast majority of the organizations considered are subdivided into a number of almost autonomous companies or branches, located around the globe. Having said that, however, this lack of an overall introduction strategy does apparently not necessarily hold for fairly new companies, which have been founded in the 'Information Age'.

Typically, IT-related decisions have been made at location, departmental or site level. Obviously, this did pretty soon lead to very heterogeneous IT environments. The same holds for messaging systems and services purchased. To even aggravate this heterogeneity, different generations of equipment need to be dealt with, including mainframes, minis and workstations as well as an ever increasing number of personal computers.

Considering the conglomeration of IT equipment outlined above, it is little wonder that global, enterprise-wide strategies didn't come into the game only pretty early. Rather, it turns out that such strategies are defined at some later stage. That is, the number of users has to reach a 'critical mass' before it is realized that a central management action is urgently required.

The following introduction 'strategy' holds for about two thirds of the organizations we have talked to:

For one reason or another, a group of employees happens to get a messaging tool. This may for example be part of an office automation tool purchased, or be integral part of a newly purchased machine's operating system. Little wonder, the new service soon becomes popular with its users. Slowly, mainly by words of mouth, information about benefits provided by the new messaging service spread throughout the whole department. The number of users increases steadily. Still, this does not happen at organizational level, but at departmental or site-level. However, at the same time very similar developments take place at many sites, obviously resulting in an extremely heterogeneous environment. This is the typical 'bottom-up' approach.

Subsequently, at some stage, a central entity takes over and tries to harmonize the different services. This harmonization is primarily required because of system incompatibilities, causing possibly severe degradation of the enterprise-wide communication quality, which, in turn, may be very costly and frustrating for users. Unfortunately, this harmonization may cause problems in terms of funding. Typically, senior management need to be convinced that the major expenditures related to purchasing, installing and maintaining a (more or less) homogeneous e-mail service are justified. Finally, compatibility with the existing legacy systems will be another major problem.

'Top-down' is obviously another straightforward approach. This has the advantage of avoiding the need to convince senior management, that introduction of the service will be backed, and thus progress rather smoothly. Compatibility issues can be solved more easily (if they occur at all, that is), and a solution providing homogeneous services throughout the whole organization will be much more cost-effective. However, it seems that this is just not the way it goes - it has turned out that only very few organizations had adopted this approach. In fact, it were either the smaller ones, or those that were 'born' into the Information Age. In any case, 'top-down' only eases the introduction of the first system, subsequent moves, as eg. from mainframe-based towards LAN-based, still imply considerable problems, primarily in terms of funding.

One hybrid strategy is worth mentioning, as it integrates the two apparently mutually exclusive approaches outlined above. It was adopted by a large France-based chemical group, and is a very interesting example of a bottom up development steered and controlled by a top-down design:

Sales staff and a special communication group were the first to be involved in the project. A simple strategy was adopted: people who were supposed to be interested in trying and testing new techniques were persuaded to use the new e-mail service. Those people then had some sort of catalyst function within their respective departments, they led the further introduction of the system. Messaging could be demonstrated as being an attractive service.

The idea of this introduction strategy was to show that there is always a choice how to communicate both internally and with business partners. It is possible to use phone, fax, or even messaging. It was always made clear that messaging was not intended to be a replacement of other well-known communication methods, but an additional service. Messaging is as easy to use, and as effective as other communication services available until then. Stressing these facts was considered crucial, as gaining users' confidence has always been a vital part of the internal marketing strategy.

Eventually, management and other senior personnel learned about e-mails' benefits, largely by word of mouth. Once these people were enthusiastic about messaging, it soon became an important tool in their departments within a very short time. It turned out that people suddenly found they had various obligations that forced them to use e-mail. In fact, this was simply because colleagues or superiors were using the system.

This development was supported by group meetings, where messaging had been presented, with senior staff sharing their messaging experiences. Such private success stories and experiences, as well as concrete business cases contributed significantly to the systems' further distribution.

The Second Stage

Once mainframe-based e-mail had been established, and had been up and running successfully for a while, most enterprises started looking at more flexible and feature-rich systems, which are typically running on either a PC or unix machine. Another noticeable development, in fact supporting this migration was the at some time popular move away from (mainframe) IBM to smaller (unix-based) systems. In contrast to the initial service introduction, this move was always part of an overall company IT-strategy.

However, whilst flexibility and functionality were not the major reasons for the typical strategic move towards a LAN- or unix-based messaging environment, there was also another crucial issue that had to be addressed. As has been said earlier, at some stage most companies somehow had to cope with, and to integrate, a considerable number of heterogeneous systems, which had evolved at different sites. For some companies, the number of systems they had to deal with was somewhere between ten and fifteen, which was not only costly in terms of maintenance, but also led to enormous problems concerning interoperation between the single systems. Fig. 1 depicts part of a typical environment of this stage. The different systems in use are interconnected through one company-wide backbone network. At least in Europe, this backbone is usually an X.400 network, provided by one (or more) public service providers (such as British Telecom in the UK).

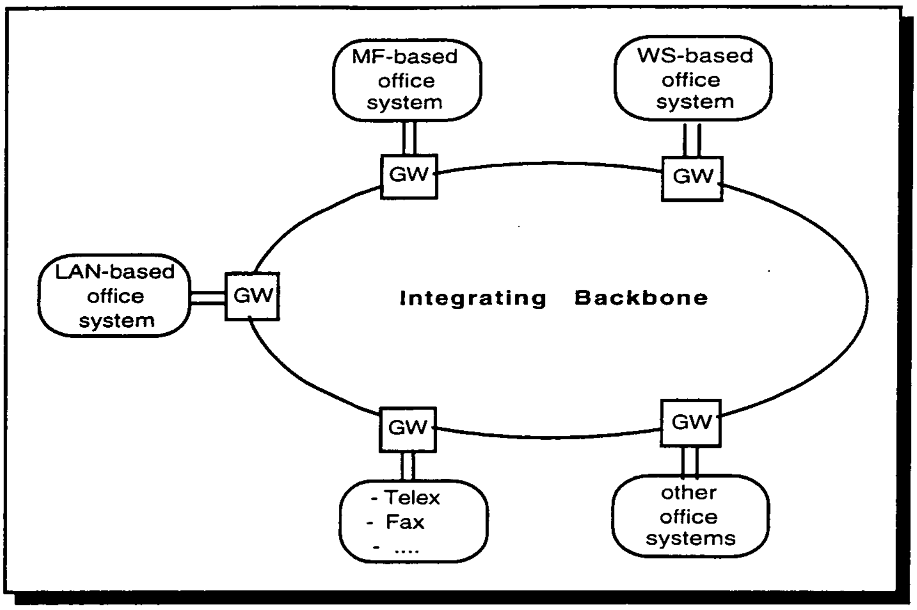

Fig. 1: A Typical Environment at the Second Stage
MF = Mainframe, WS = Workstation, GW = Gateway

In contrast to the service uptake (mainframe-based services, that is), the respective next steps were quite different. Whereas there is a general trend towards a higher degree of service distribution, this has been achieved via different evolution paths (cf. fig. 2).

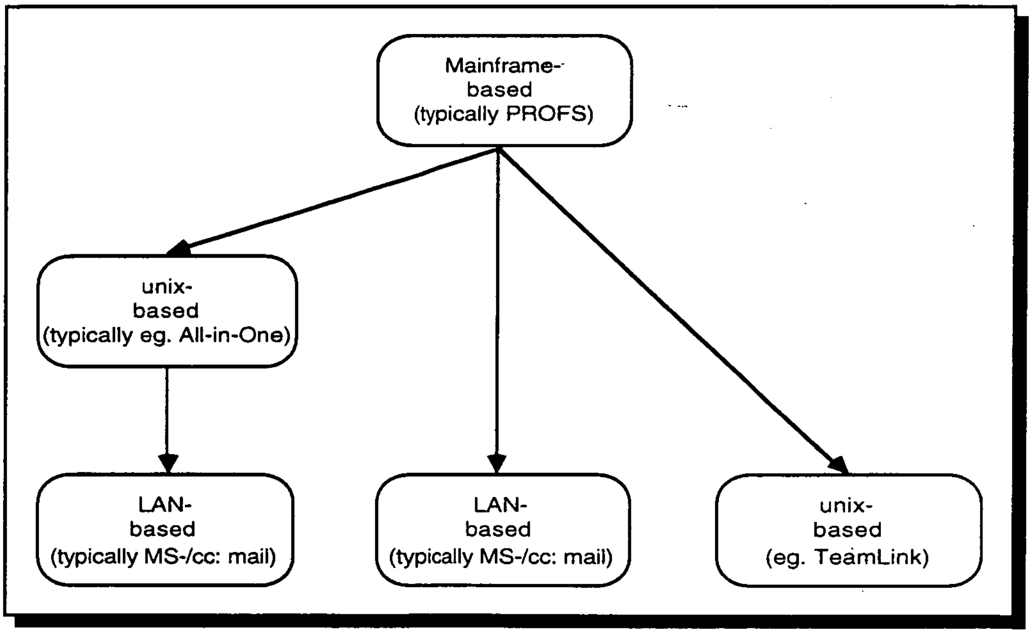

Fig. 2: Typical Evolution of Electronic Mail Service Platforms

At least as far as the organizations studied are concerned, LAN-based systems dominate. In fact, some companies have gone to great lengths to push forward such systems, a move typically resulting in different problems, which might include:

- **Financing**
  Establishing the first systems did not cause much (financial) headache. However, convincing senior/top management that a move from an apparently working service towards something new was typically quite difficult.

- **Service uptake**
  Despite their various advantages, LAN-based systems cause a considerable extra overhead compared to centralized mainframes.

- **Convincing users**
  Once people got used to a certain service, it is hard to persuade them to use something else instead. This holds all the more if this new service is still in its infancy, and causes problems for some time.

- **System interconnection**
  Almost everyone wants to have only one e-mail service in the company. However, it seems that this just cannot be achieved, for whatever reasons. Consequently, a interconnecting (and possibly integrating) e-mail backbone had to be established as well.

However, whatever the initial introduction 'strategy' and the subsequent development might have been, one sentence can serve to characterize the typical view of many e-mail users today: 'Just couldn't do my work without it'.

END-USER ISSUES

This chapter discusses the steps taken to keep their users happy, and to maximize usefulness of the electronic mail service. Topics to be addressed include recognition of initial user requirements, user training, support facilities, and provision of established channels to forward eg. complaints, suggestions, problems or new demands.

Initial Requirements Analyses

At least on the face of it you should think that large companies did have a clear understanding of what they were heading for in terms of electronic mail. They don't (well, most of them anyway). However, come to think of it, and given the normal e-mail evolution pattern, this is not too surprising after all.

Only one of the companies of our survey had done a requirements analysis prior to the installation of their first corporate e-mail system. This can be largely attributed to the fact that little alternatives were out on the market in, say, the early eighties. What's even worse, for almost all companies the mail system had to fit into their existing IT environment. Little wonder that PROFS was highly popular.

User Training And Support Facilities

Attitudes vary with respect to user training. Statements range from 'Full user support on technical issues is provided on site, including user training' to 'User support enjoys comparably low priority'.

The majority considered (re)training of users as being of principal importance. A substantial amount of time and money has gone into these issues, which include initial training courses for prospective users as well as management and support staff; 'training the trainers' being a popular first step. Moreover, special staff is being employed by some. In addition, specific manuals are provided at some organizations.

On the other hand, two companies said that user training is low on their respective priority lists. Although this number is definitely too small to draw any general conclusions, it should be noted that one of these companies sees itself as being 'still at an early stage of e-mail use' (after about eight years), with the other admitting that 'despite their efforts e-mail is not widely used'. Despite the different attitudes towards training, help-desks have unanimously been declared as being crucial. In fact, every company offers access to a help-desk facility to its users, either internally or through a third party.

Reacting to User Comments

The companies show similarly diverse approaches towards compilation of and reaction to user reports, suggestions and complaints. Whereas some do have rather sophisticated mechanisms in place for automatic logging of such user input, and have formally established bodies to analyze and react upon these reports, others simply leave it to the help-desk staff. Little surprise that the useful user input received is reflecting the respective approaches: users who know that their comments will be considered seriously appear to be much more willing to actually submit them (Jakobs 1994).

One of the more sympathetic companies in terms of user comments states that decisions related to e-mail are very much user driven these days. Users can submit requirements of whatever kind electronically, and they have a major impact to future e-mail developments. A field request logging system is in place, through which comments etc. can be sent to a central site where full-time staff are in charge of analyzing these requirements, which are then forwarded to the responsible product manager. In addition to that, a communication user group of about 30 people at primarily senior management level are championing user requirements, express their respective local issues and try to find acceptable compromises. Prior to a new product release, both a draft and a total requirements study are performed. So far, this approach has worked very well.

Another report on user behaviour said that about four years after system introduction some 50% of the users were in a so called 'bad traffic' zone. That is, they received or sent less than one mail per day on the average. It turned out that most of these 'bad' users stated that 'it is not my fault that the traffic is that bad, there is nobody in the company who is willing to send me a message!'. Three years later, half of these once 'bad' users had become 'normal' users, that is, they sent/received 5 - 10 messages per day. This was primarily due to the better connectivity provided by an enhanced infrastructure (X.400 based). Better integration of messaging services into the normal working environment also lead to improved utilization figures.

The conclusions of the study were:

- users had made good experience with the new service 'messaging',
- progress has to be made in terms of enhanced services
- messaging will lose attractiveness if people will not receive 'enough' messages.

ORGANIZATIONAL IMPACT

Some companies acknowledge that e-mail had at least contributed to organizational changes. The most prominent effect observed was that it has helped create a flatter hierarchy, with complete management levels having vanished after its introduction. It should, however, be noted that e-mail was only a contributor to this development, it didn't prompt it. Moreover, it may not always be absolutely clear whether e-mail actually has contributed to the downsizing of an organization, or whether the downsizing has increased the importance of e-mail. E-mail enabling a flatter hierarchy can largely be contributed to the newly gained ease of communication with senior management, and to the generally identified boost in efficiency it has created.

Another effect identified and worth mentioning is that is was e-mail that enabled the establishment of spin-off companies. These companies typically cover a niche market of their parent organization, and can do so much more efficiently if working independently, whilst maintaining close (communication links).

SOME CONCLUDING REMARKS

Electronic mail is being introduced by an ever growing number of organizations. Whilst e-mail does not necessarily guarantee any improvements for the corporate user per se, it apparently boosts efficiency of work, eases otherwise tiresome tasks, and may contribute to streamlining the organization (which, on the other hand, may be received badly by the employees effected).

Training users well in advance, and reacting to their requirements are major cornerstones, and apparently contribute to the usefulness of the service, which is likely to be raised even further once e-mail has become integral part of the business process. Despite the obvious successes, we would like to stress that ignoring these facts may well lead to a failure of even the most sophisticated and originally useful new technology.

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Corporate E-Mail in Europe - Requirements, Usage and Ways Ahead

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Abstract

Although electronic mail is by far the most popular data communication service, comparably little is known about the problems associated with its introduction and use. This paper looks at different issues, both technical and non-technical, and report the results of a number of interviews with corporate IT managers. It turns out that few of the technical problems identified actually stem from inadequacies of the standards documents, but from incomplete implementations. With respect to non-technical issues, introduction strategies, requirements analyses and user support are the most crucial points.

1 BACKGROUND AND MOTIVATION

Electronic Mail has made its way into the offices of virtually all large international organizations. Recent studies on this subject (e.g. [Ovum 94]) suggest that once it has been introduced at an organization-wide level e-mail yields considerable advantages over 'traditional' communication media such as letter, telex, fax, and phone. This holds not only for internal communication, but all the more if external business partners are accessible this way, too. Major benefits identified include savings of time and money, process simplification, as well as enhanced reachability and cooperation.

Despite these significant advantages, however, companies have been left with a number of problems to grapple with. On the one hand, these include technical issues like integration of heterogeneous systems already in place at different sites

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('legacy' systems) and functional shortcomings of standards and services [EEMA 94]. On the other hand, there are the non-technical issues, including how to introduce the new technology, how to train users, and what to do about upcoming new requirements. Surprisingly, perhaps, very little has so far been published that might serve as examples and guidelines for companies when tackling these problems. This paper will try to address their needs.

As we are reporting on European organisations, it should be noted that X.400 [ITU 92a] is the one system prevailing in the corporate environment there, rather than the Internet. This paper will therefore focus on X.400 as well.

Considering technology-related problems, section two discusses issues raised during interviews with senior members of the European IT departments of large, international organizations from very different business sectors including, but not limited, to finance, chemistry, aviation, and oil. We will identify the major requirements, and will subsequently discuss if and to what degree they can be met by systems based on today's standards (section three).

The other major goal of the interviews was to discuss and analyse the non-technical issues. The focus of this analysis (section four) will be on introduction strategies employed, with end-user related issues like requirements analyses, and user training and support being discussed subsequently in section five). Finally, some concluding remarks will be given.

2 COMPILING USER REQUIREMENTS

Assembling user requirements is an important first step towards a usable and useful service. Therefore, this section summarizes actual requirements identified by large corporate users from Europe. Only the more prominent requirements, ie. those identified by several users are presented. It should also be noted that these requirements result from considerable experience with corporate e-mail systems; each of the companies studied has been using e-mail for at least ten years.

The most urgent requirements include:

- **User-friendly addressing**
  By far the most popular single requirement. Current X.400 addresses have almost unanimously been identified as a 'pain in the neck'. They need to be short, guessable and straightforward, and should not carry routing information.

- **Notification services**
  Various types of notification services are required, to verify eg. delivery/non-delivery of messages, or to indicate whether or not a message has actually been read by the person(s) for whom it was intended. One step further, status reports should be available to the sender of a message, including the ability to trace lost messages, to ensure non-repudiation by sender and recipient, and to associate recorded security events with the message trace.

- **Directory synchronization**
  Historically, different proprietary directory services have been employed by most organisations, leading to the urgent need of tools, mechanisms and/or services ensuring consistency of information throughout the organisation.

- **Enhanced security features**
  As it is used at present, e-mail is far from being secure. Multiple security levels will be required to meet the broad range of requirements. To allow for serious (ie. primarily business) usage of e-mail security mechanisms to be provided include:
  - integrity: the message is transferred intact, without any changes or additions,
  - encryption: message content is only decipherable by the intended recipient,
  - authentication: originator and/or recipient are authenticated,
  - privacy: specifies access rights to messages.

  Moreover, mechanisms to detect and protect against viruses in messages and attachments should be provided.

- **Multimedia messaging**
  Given that multimedia mail is a buzzword, there appear to be surprisingly few real user requirements in that area. The support of different national character sets is most popular (which is understandable in Europe), followed by support of an External Body Part. Both require a standardized encoding scheme.
  As an intermediate step, service providers should at least support transmission of binary files.

- **Understandable and uniform error messages**
  The contents of notifications intended for human users should be in plain, understandable language rather than, say, numeric error codes.

- **More comfortable editing, retrieving and re-using of messages**
  The user should be provided with mechanisms that allow him to manipulate messages received or to be sent in a most convenient way. This includes the capabilities such as
  - hierarchical mailboxes,
  - filtering functions,
  - integration of a more sophisticated editor,
  - refiling outgoing messages.

3 MEETING REQUIREMENTS

The requirements as they are listed above cover a broad range of issues, including some beyond pure service functionality. Content and form of error messages, for instance, can hardly be regulated by a service specification document; aspects like editor integration are clearly a purely local matter.

Thus, a distinction has to be made between what is in a standard or service specification, and what is actually being implemented and offered. It is fairly common, at least in the X.400 world, that service providers only implement certain subsets of the respective recommendations. Again, whilst this is a nuisance for the user, it is beyond the scope of the standards documents.

In fact, it is quite surprising how few of the requirements listed above refer to service specifications; the majority are more related to organizational, policy or implementation issues. Moreover, the majority of the requirements are being met by the functionality specified in the X.400 documents. Still, a few shortcomings of the specifications can be identified, including:

- **User-friendly addressing**
  So far, fairly little has been done about this problem. The only related standards document [ITU 92b] provides little more than an extended description of possible X.400 addressing structures, but does not offer any more user-friendly alternatives. In fact, it is more than doubtful that something will ever be done about X.400 addressing as such in the near future. This is not least because of the standards assuming availability of a global X.500 directory service [ISO 92]. Unfortunately, this service has yet still to materialize.
  However, even the X.500 service in its current form will require enhancements in terms of user-friendliness. This is largely due to the fact that X.500 'distinguished names' are far from being user-friendly at all. However, standard compliant proposals how to achieve user-friendly naming using X.500 are available [Kille 95a], [Kille 95b].

- **Directory synchronization**
  As any global directory service will necessarily have to be distributed, and information will be replicated, information inconsistencies may occur. X.500 allows temporary inconsistencies during the replication process, called 'Shadowing' in X.500. This is opposed to 'Caching', which refers to data being stored locally by a user. As the latter is not controlled by the system, cached data may well become invalid without notice.
  In general, there are two ways to avoid inconsistencies:
  - To use an underlying protocol that guarantees consistency, for instance a two-phase commit protocol, as eg. OSI CCR (Commitment, Concurrency and Recovery). This ensures that inconsistencies cannot occur by blocking data until update is completely finished. However, with a globally distributed service and a considerable daily number of update operations, this is by no means a realistic option.
  - To do no replication at all. Whilst this is possible, it would severely decrease availability of data and performance of the overall system. Again, this is not a realistic solution.

  There seems to be no way to overcome this problem by means of a communication service; yet higher performance of the overall service might improve the situation. In particular, faster implementations, dedicated high-priority 'update'-messages and elaborate caching strategies might be worth considering to achieve increased performance.

- **Multimedia messaging**
  The X.400 recommendations specify a number of different body-parts. Unfortunately, they do not specify the respective encoding rules. For the time being, a change appears to be most unlikely. Thus, only bilaterally, nationally, or externally defined body parts can be used, together with user-defined encoding schemes.

Participation in Standardization

Active participation in the standards setting process might be considered one possible approach to overcome the above - and, of course, other - perceived deficiencies, and to ensure that functionality required in the future will actually be provided by e-mail services. This holds all the more as the organizations considered are extremely large users with a strong business interest in e-mail.

It appears, however, that even users with a very favorable attitude towards e-mail show little interest in addressing perceived service inadequacies by seeking to influence standards setting (eg [Jak 95b], [Sal 93]). Interviewees typically commented that their companies do not see any business benefits in standards activities and are thus not prepared to spend considerable amounts of money on people travelling to meetings and working on standards committees. Rather, they would talk to their service providers and/or implementors, be active in dedicated user groups, or consider user organizations (eg the European Electronic Messaging Association, EEMA) as being in charge of pushing user demands. Having said that, however, it is also worth mentioning that standard-compliance has been a major selection criterion for the respective corporate systems.

Another prevailing general impression that lingers on from the interviews is that functionality of a corporate messaging system is - at least for the time being - one of the less important selection criteria. Thus, it comes as less of a surprise that large corporate users do not normally aim at getting involved in the standardization process.

A First Résumé

Analyzing the requirements identified above indicates that the vast majority of those not being met by today's systems relates to policy, organizational, or implementation problems rather than insufficient functionality as described in the X.400 standards documents. This leads to the preliminary conclusion that these standards are not that bad after all. However, it must be clearly stated here that this conclusion is by no means final. The next step will be to get a much more detailed picture of what users actually expect from their messaging services. An in-depth study into this matter has just got off the ground.

Trying to explain the apparent reluctance to participate in standardization, a few observations and conclusions are helpful:

- For quite some time other, more down-to-earth e-mail related issues had to have higher priorities (like eg. providing reasonably smooth interworking between different systems).

- Strategic planning in this area has started only fairly recently, in particular, e-mail has not yet been part of strategic applications. Therefore, little, if any, additional functionality has been needed so far.

- Problems identified stem largely from inadequate implementations of the standards rather than flawed standards. As one consequence, the direct links are to system vendors and service providers rather than to the standardization bodies.

This is seconded by two notions: first, a requirements analysis, the outcome of which would be the basis for any participation in standards bodies has not normally been performed. Second, apparently US organizations are more active in standardization bodies. Given that, in terms of corporate e-mail usage, the US are a couple of years ahead of Europe, we may expect to observe a similar development in Europe in about three to five years time; more data will be needed to substantiate this prediction.

4 INTRODUCING CORPORATE E-MAIL

This section outlines the typical - though not the only - introduction strategies employed at the different stages of the introduction of a corporate e-mail service. We will link theses strategies to the respective 'history' of messaging, that is to the situation that had emerged within each organization before a corporate strategy took over. As will become clear, in the vast majority of case study organizations a real strategy was implemented only at a rather late stage, though without apparently detrimental effects so far.

Our study suggests that large, international enterprises do not normally make overall strategic decisions concerning messaging services at the very beginning of this technology penetrating the company. This result may partly reflect the structure of the case study organizations, the majority of which are subdivided into a number of almost autonomous companies or branches, located around the globe.

Typically, we found that IT-related decisions were made at departmental or site level. The result of this was that their IT environments, particularly including messaging systems, were generally very heterogeneous. In general, this heterogeneity was aggravated by the existence of different generations of equipment, including mainframes, minis and workstations as well as an ever increasing number of personal computers.

Considering the conglomeration of IT equipment outlined above, it is little wonder that global, enterprise-wide strategies came into play at a relatively late stage in the development of e-mail services. It would seem that the number of users has to reach a 'critical mass' before it is realized that a central management action is urgently required.

Broadly speaking, it is possible to distinguish between two different general types of introduction 'strategies' for corporate e-mail which we will refer to as 'bottom-up' and 'top-down', respectively. There are, however, hybrid approaches as well [Jak 95a]. We will limit our discussion to the following introduction 'strategy', which holds for about two thirds of the organizations within the case study.

The Takeoff

A group of employees obtains a messaging tool, either to fulfil a specific work requirement, or bundled in with other software.

> *"The first e-mail system was installed as part of a major IT project, when it was merely considered a tool enabling cooperation between project teams in 17 European countries. Its introduction was part of the project roll-out, and based on a management decision."*

> *"Use of e-mail emerged from the use of VAX-mail (which came for free with the operating system)."*

The new service soon becomes popular. Slowly, mainly by word of mouth, information about benefits provided spread throughout the department.

> *"Word processors were bought, with e-mail being an integral part of this package, to be used by secretarial staff. Since then, electronic mail has made its way into other offices and departments."*

The number of users increases steadily, though still within the department or site, rather than at the organizational level. However, at the same time very similar developments take place at many sites, resulting in an extremely heterogeneous environment -- the typical 'bottom-up' approach.

The Second Stage

Subsequently, at some stage, a central entity takes over and tries to harmonize the different services with management backing.

> *"Originally it was an effort led by techies, now it has much management support."*

This harmonization is primarily required because of system incompatibilities, causing possibly severe degradation of the enterprise-wide communication quality, which, in turn, may be very costly and frustrating for users. Unfortunately, this harmonization normally causes problems in terms of funding. Typically, senior management need to be convinced that the major expenditures related to purchasing, installing and maintaining a (more or less) homogeneous e-mail service are justified. Finally, compatibility with legacy systems has been another major problem.

Eventually, most enterprises started looking at more flexible and feature-rich systems, which are typically to be found on either PCs or unix machines. Another development supporting this migration was the then popular move away from (mainframe) IBM to smaller (unix-based) systems. In contrast to the initial service introduction, this move was always part of an overall IT-strategy. However, as was stated earlier, most of the case study organizations had to integrate a considerable number of heterogeneous systems, which had evolved at different sites. For some, the number of these systems was between ten and fifteen, which was not only costly in terms of maintenance, but also led to enormous problems concerning interoperation between the single systems. Figure 1 depicts part of a typical environment of this stage.

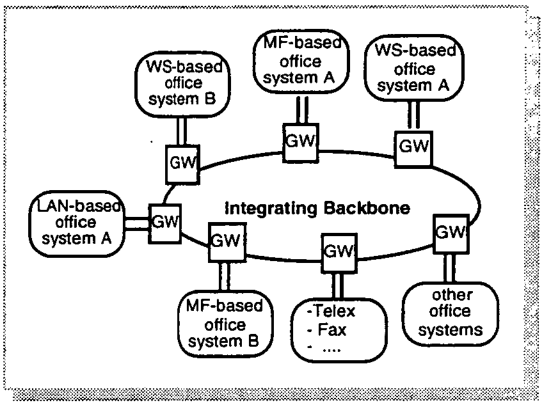

Figure 1: A Typical Environment at the Second Stage
MF = Mainframe, WS = Workstation, GW = Gateway

In contrast to the original (i.e. mainframe-based) service uptake, the respective next steps were quite different. Whereas there is a general trend towards a higher degree of service distribution, this has been achieved via different evolution paths (Figure 2).

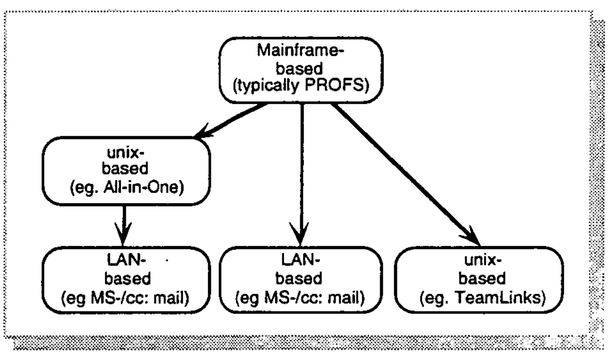

Figure 2: Typical Evolution of Electronic Mail Service Platforms

The Third Stage

This stage, which many of the case study organisations are currently pursuing, is a continuation of the previous one, and is characterized by the introduction of a uniform local e-mail environment (e.g. MS-Mail or cc:Mail), interconnected through a messaging backbone (typically an X.400-based system or the Internet), which also offers access to the respective other e-mail world (i.e. the Internet or X.400) [Jak 94].

> *"Until we've got to the stage we've got an entire user population on one e-mail system we're going to have a degree of user annoyance."*

Some of the case study organizations have gone to great lengths to push forward LAN-based systems, a move typically also resulting in problems, including:

- **Convincing management**
  The establishment of the first e-mail systems was achieved fairly painlessly and without major financial expenditure. However, convincing top management that a move from an apparently working service towards something new was typically quite difficult.

- **Service uptake**
  Despite their various advantages, LAN-based systems incurred a considerable extra overhead compared to centralized mainframes.

- **Convincing users**
  Once staff got accustomed to using to a certain service, organizations found it hard to persuade them to use something else instead. This was even more the case if the new service was still in its infancy, and likely to cause problems for some time.

- **System interconnection**
  There was almost universal agreement that a single e-mail service was the best solution for organizational messaging needs. However, this proved to be very difficult to achieve in practice. Consequently, most organizations have opted to establish an interconnecting (and integrating) e-mail backbone instead.

Completion of this step means that a homogeneous service will be available for most, if not all, users, and that the number of different gateways will be minimized. Effectively, this should lead to a service considerably easier to manage and maintain, which should in turn lead to a higher degree of acceptance and thus usefulness of the e-mail service.

5 OTHER CONTRIBUTORS TO A SUCCESSFUL SERVICE

This section briefly discusses other steps that might be taken to increase usefulness of an e-mail service, including recognition of initial user requirements, and user training and support facilities.

Initial Requirements Analyses

Given the typical pattern of e-mail introduction outlined in the previous section, it is not surprising that only one of the organizations in our survey had done a requirements analysis prior to the installation of their first corporate e-mail system. Furthermore, even if this step had been taken, it would have been a somewhat nugatory exercise, given that few alternatives were available on the market in the early eighties, the period in question. Even more constraining was the fact that in almost all cases, the e-mail system had to fit into the organization's existing IT environment.

We do feel that this lack of foresight is a major contributor to today's complications, although it probably was not completely avoidable.

User Training And Support Facilities

Attitudes varied with respect to user training. Comments ranged from *"Full user support on technical issues is provided on site, including user training"* to *"User support enjoys comparably low priority"*. This is quite surprising, given the fact that the importance of user training has long been recognized, (see e.g. [Nel 87]).

The majority of the organizations considered (re)training of users as being of principal importance. In most cases, a substantial amount of time and money has gone into these issues, which include initial training courses for management and support staff; 'training the trainers' being a popular first step. Moreover, staff are employed by some of the organizations to serve in a training role, and to produce specific service documentation.

One company, which insists that staff follow an introductory training courses, considers e-mail as a major (positive) part of today's corporate culture, a view with which staff apparently concur. On the other hand, two companies said that user training is low on their respective priority lists. Although this number is certainly too small to draw any general conclusions, it is nevertheless interesting to note that one of these latter companies sees itself as being "still at an early stage of e-mail use" (after about eight years), with the other admitting that "despite their efforts e-mail is not widely used".

As discussed earlier, the initial, uncoordinated stage of e-mail service implementation is typically followed by a more concerted attempt to integrate and harmonize services. This can be problematic, however, at both the technical and user level. Some of the case study organizations have realized that forcing users to move from one e-mail system to another is not a good policy. Rather, they have tried to 'persuade' their users to move in the desired direction, by offering, for example, migration tools and better support facilities for the new service, yet whilst retaining (for some period) interconnection to the old one.

Despite the different attitudes towards training, the case study organizations are unanimous in their belief that help-desks crucial to success. In fact, every of them offers access to a help-desk facility to its users, either internally or through a third party.

Another Brief Résumé

From our interviews it can be concluded that inadequate handling of the non-technical issues related to e-mail may very well hamper the successful uptake of the service within an organisation. Experiences of the various companies suggest that a thorough requirements analysis prior to service uptake, in conjunction with timely provision of adequate user support facilities should avoid most of the problems our case study companies had to struggle with.

Another consequence worth mentioning is that some companies acknowledged that e-mail had at least helped create a flatter hierarchy, with complete management levels having vanished after its introduction. This can largely be contributed to the newly gained ease of communication with senior management, and to the generally identified boost in efficiency it has created. Whilst this effect will be welcome from the corporate point of view, it will not exactly help make the service popular with its prospective users. This should be kept in mind as well.

6 SOME FINAL REMARKS

Electronic mail is being introduced by an ever growing number of organizations. Whilst this does not necessarily guarantee any improvements for the company in itself, it seems likely to generate real business benefits. Internally, this is achieved through a widely acknowledged boost in efficiency of work. Externally, easier and more efficient communication with business partners is rated a very important benefit.

Technical problems and issues that need to be solved are comparably minor. Moreover, most of them stem from the fact that service providers to not fully implement the set of recommendations that establish the X.400 service. This leads to an urgent need for users to talk to their respective service providers and vendors in order to get a service that lives up to their expectations.

Moreover, with the ongoing diffusion of electronic messaging services into companies and organizations, and especially with the integration of e-mail into business-critical processes, we would predict increasing user involvement in the standardization process as well, as we assume that eventually functionality problems will surface due to this integration.

Despite these technical problems, it seems that they take second place to the non-technical issues when it comes to contributions to a successful service. An introduction strategy that incorporates requirements analysis, training of users well in advance, and appropriately reacting to user feedback are major cornerstones of a successful corporate e-mail service. An e-mail service which is not at odds with established working procedures and which is to be used by well-trained employees, is most likely to leave both, employer and staff satisfied. Above all, adequate training appears to be crucial for a successful uptake of e-mail services.

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SOME NON-TECHNICAL ISSUES IN THE IMPLEMENTATION OF CORPORATE E-MAIL: LESSONS FROM CASE STUDIES

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ABSTRACT

This paper addresses some of the non-technical issues associated with the adoption and development of electronic messaging in large international organisations. The results of case studies of organisational implementations of e-mail services are presented, and the strategies employed analysed. Subsequently, end-user issues and problems of messaging services are discussed. We examine the different degrees of user training and support offered, and the mechanisms in place allowing end-users to contribute to subsequent service developments and enhancements. We conclude with recommendations for tackling some of the problems observed.

KEYWORDS: electronic mail, IT implementation strategies, end-user innovation

INTRODUCTION

One of the central dilemmas in the organisational implementation of Information Technology (IT) today concerns the relationship between the central and the local. On the one hand, the vision of the strategic application of IT advanced, for example, by proponents of Business Process Re-design (Hammer and Champny, 1993), implies a centrally planned, top-down design and implementation of systems coupled to a radical transformation of organisational practice. On the other hand, research into IT implementations has revealed the importance of bottom-up strategies allied to local individual and collective learning processes in which technical potential is explored and fitted to the specific current and emerging requirements of groups of organisational end-users (Friedman, 1989; Fleck, 1994). The latter points to the contingency and heterogeneity of organisational information systems, viewed as complex configurations of diverse technologies and working practices. However, such a heterogeneous approach to IT systems remains problematic in relation to distributed IT systems, which exhibit strong network externalities -- i.e. where the value for each user of being on the network increases with every new player joining the network. For example, if different local systems are incompatible, this will limit the benefits available from using the system.

For distributed IT systems such as electronic messaging services, two kinds of barriers to successful implementation may be particularly important. The one most commonly recognised is at the technical level of interoperability, where differences between various proprietary solutions or different generations of technology may mean that systems cannot interoperate or that some functions cannot be shared. However, another, potentially more significant barrier in terms of the cost and effort needed to overcome it arises from the commitment of end-users to their own locally-chosen systems -- which may represent a substantial investment made by large numbers of people to learning how to use a system and to apply its functionality to their working activities. This may result, for example, in a reluctance on the part of some end-users to comply with the imposition of organisation-wide, standardised services.

We explore these and other, related issues through of a number of case studies of the implementation -- i.e. adoption and development -- of e-mail services in large, international organisations in a variety of different business sectors including finance, chemistry, aviation, and oil.

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BACKGROUND AND MOTIVATION

The work reported here is part of a wider project examining those factors contributing to useful and usable electronic messaging services. Previous work has focused on the processes by which messaging standards are defined. The growing requirement for interoperability has established the need for standardised communications services. More recently, messaging standards have targeted higher level services, and the results have direct consequences for usability. Thus, the achievement of the desired high levels of usability makes it increasingly important to understand how standardisation processes work and, in particular, if and where they fail to address users' requirements, and why (Cargill, 1989; Hawkins, Mansell and Skea, 1995; Jakobs, Procter and Williams, 1996).

E-mail was selected for in-depth study because it is by far the most popular network application, being utilised by an ever increasing number of users with diverse backgrounds and expectations. E-mail has by now made its way into the offices of virtually all large international organisations. Recent studies (e.g. Bagshaw and Lockwood, 1994) suggest that once it has been introduced at an organisation-wide level -- and thus network externality benefits fully exploited -- e-mail yields considerable advantages over traditional communication media such as letter, telex, fax, and phone. This holds not only for internal communication, but all the more if external business partners are accessible this way too. Major benefits identified include savings of time and money and process simplification, as well as enhanced reachability and cooperation.

Despite these significant advantages, however, companies implementing e-mail services have found themselves facing a number of problems. There are many factors which may impact upon the adoption of e-mail services and their subsequent take up and usage. Those of a more technical nature, such as functionality, reachability etc. are well-documented (Race Industrial Consortium, 1995). This paper focuses upon organisational factors and, in particular, the strategies employed (if any) in the adoption and development of e-mail services. We report on how organisations have responded to the problems of interoperability and the dilemma of bottom-up versus top-down implementation strategies, and the degree of attention paid to end-user issues such as training, the provision of adequate support facilities, and establishment of effective channels for user feedback as development proceeded.

METHODOLOGY

The study focused on large, globally operating enterprises. It was assumed that such companies would be more likely to have gained considerable experience with e-mail syste to have employed real introduction strategies, and to h implemented adequate mechanisms to cope with u comments. Membership in user organisations -- e.g. European Electronic Messaging Association (EEMA) -- another selection criterion, as it was felt that s membership was indicative of a higher than average de of interest in the subject. Companies studied were from different sectors, including but not limited to finan information brokering, transport, and petro-chemic Finally, the study was geographically limited to UK-ba companies and branches.

Fifteen senior members of IT departments who represented their respective companies within EEMA w interviewed. Typically, interviews lasted between one three hours, and focused on:

- general experiences of electronic messaging services,
- introduction strategies used (if any),
- approaches how to address user-related issues,
- technical shortcomings of the systems used, if any, a
- how such shortcomings were overcome.

In addition to these face-to-face interviews, some comp representatives were interviewed through questionnaires. both cases, a common set of twenty-two open-enc questions was employed.

E-MAIL IMPLEMENTATION STRATEGIES

In this section we will describe and categorise the differ strategies for the adoption and development of compa wide e-mail services within our case study organisatio and discuss their respective pros and cons. In doing so, i necessary to link these strategies to the respective history messaging services, that is to the situation that had emerg within each organisation before a central, corporate, to down strategy was imposed. As will become clear, in t vast majority of case study organisations such a strate was implemented only at a rather late stage. Only rarely w there evidence of a top-down strategy being follow throughout adoption and development (Jakobs and Fichtn 1995).

Top-Down Strategies

The advantage of pursuing a top-down strategy right fr the beginning of e-mail service implementation is th compatibility issues are more easily resolved and a soluti providing homogeneous services throughout the who organisation will be much more cost-effective. Also, t backing of senior management removes many obstacles.

"The decision to use electronic messaging was backed by the board of directors. Accordingly, the introduction brought at least very few organisational problems."

However, one of the major drawbacks of pursuing a top-down strategy from the outset is that it removes the opportunity for individual and organisational learning, which may have serious consequences for the success of the project (Attewell, 1992). This was the experience of one of our case study organisations, where the introduction of e-mail was initially confounded by users' resistance to change. This resistance was itself directly linked to the fact that at that time the project began, e-mail's benefits were not really understood.

"In 1984, it was extremely difficult to convince people that e-mail was part of their job. People considered distributing information via e-mail as something vexatious."

The organisations which followed a top-down strategy from the outset were either the smaller ones, or relatively young organisations founded within the last twenty years.

"The company was lucky in that one of its founders was quite keen on IT, so funding has not really been a problem. In the early days, decisions related to information technology in general, and to e-mail in particular, were very much taken by this person."

Even in these cases, it was noted that following a top-down strategy only eased the introduction of the first system; subsequent moves, e.g. from mainframe-based towards LAN-based systems, still caused considerable problems.

Hybrid Strategies

Overall, the results of the study suggests that large, international enterprises do not normally make top-down, strategic decisions about messaging services from the very beginning. This result may partly reflect the structure of the case study organisations, the majority of which are subdivided into a number of almost autonomous companies or branches, located around the globe. The result was that end-users typically took the lead in e-mail adoption. Whether deliberate or otherwise, the benefit was the opportunity thus provided for the individual and organisational learning so often vital to the subsequent successful organisation-wide implementation of IT systems.

Typically, we found that IT-related decisions were made at departmental or site level. The result of this was that the IT environments in the case study organisations, particularly (but not only) messaging systems, were generally very heterogeneous. In general, this situation was aggravated by the existence of different generations of equipment, including mainframes, minis and workstations as well as an ever increasing number of PCs.

The consequence of a pattern of local, end-user led adoption on the one hand and the obstacles created by heterogeneous systems to interoperability on the other was the emergence of two distinct hybrid strategies which combined of bottom-up and top-down strategies, but in rather different ways. The first hybrid strategy we found holds for about two thirds of the organisations within the case study. In it, bottom-up adoption and top-down development strategies are pursued at different stages within the overall implementation process.

The Initial Stage

In classical bottom-up fashion, a group of employees obtains a messaging tool, either to fulfil a specific work requirement, or bundled in with other software.

"The first e-mail system was installed as part of a major IT project, when it was merely considered a tool enabling cooperation between project teams in 17 European countries. Its introduction was part of the project roll-out, and based on a management decision."

"Use of e-mail emerged from the use of VAX-mail, which came for free with the operating system."

The new service soon becomes popular. Slowly, mainly by word of mouth, information about benefits provided spread throughout the department.

"Word processors were bought, with e-mail being an integral part of this package, to be used by secretarial staff. Since then, electronic mail has made its way into other offices and departments."

The number of users increases steadily, though still within the department or site, rather than at the organisational level. However, at the same time very similar developments take place at many sites, resulting in an extremely heterogeneous environment -- the inevitable outcome of the bottom-up approach. The conditions potentially now exist to justify the pursuit of a top-down strategy to e-mail service development.

The Second Stage

Users now recognise the need for integration as they experience the problems of the incompatibilities between the patchwork of systems adopted at different sites. In some cases, there were more than ten different-mail systems. The degradation to organisation-wide communication quality is sometimes severe and often very costly and frustrating for users.

The case for following a central, top-down development strategy as a solution to these problems is now very strong. Unfortunately, its acceptance depends upon senior management being convinced that the major expenditures related to purchasing, installing and maintaining a (more or less) homogeneous e-mail service are justified by the benefits. A critical mass of e-mail users needs to be reached -- and individual and organisational learning needs to take place -- before the implications of factors such as network externalities may be fully appreciated and the costs of a top-down strategy thereby justified.

Attempts to institute a top-down development strategy begin: a central entity takes over and tries to integrate the different services with management backing.

> *"Originally it was an effort led by techies, now it has much management support."*

Figure 1 depicts part of a typical e-mail service environment once integration is complete. Also at this stage most organisations started looking at more flexible and feature-rich systems, which are typically to be found on either PCs or UNIX machines. Another development supporting this migration was the then popular move away from (mainframe) IBM to smaller (UNIX-based) systems. In contrast to the initial service introduction, this move was always part of a top-down development strategy.

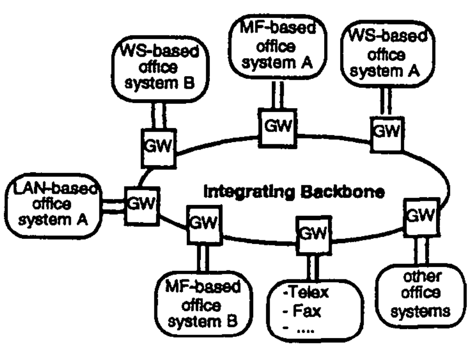

Figure 1: A Typical Environment at the start of the Second Stage
MF = Mainframe, WS = Workstation, GW = Gateway

In contrast to the original (i.e. mainframe-based) service uptake, the respective next stages were quite different. Whereas there is a general trend towards a higher degree of service distribution, this has been achieved via different evolution paths (see Figure 2).

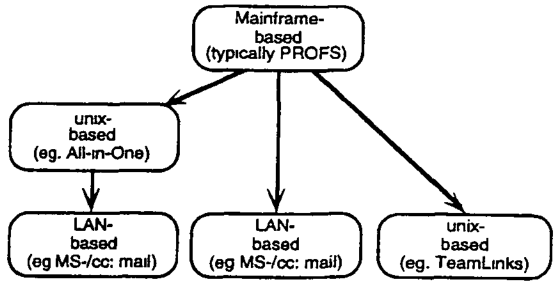

Figure 2: Typical Evolution of Electronic Mail Service Platforr

The Third Stage

This stage, which many of the case study organisations currently pursuing, is a continuation of the top-do development strategy, and is characterised by introduction of a uniform local e-mail environment (e MS-Mail or cc:Mail), interconnected through a messag backbone (typically an X.400-based system or the Interne which also offers access to the respective other e-mail wo (i.e. the Internet or X.400). Completion of this step mea that a homogeneous service will be available for most, not all, users, and that the number of different gateways v be minimised.

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- **Convincing management**
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- **Service uptake**
Despite their various advantages, LAN-based syster incurred a considerable extra overhead compared centralised mainframes.

- **Convincing users**
Once staff got accustomed to using to a certain servic organisations found it hard to persuade them to u something else instead. This was even more the case the new service was still in its infancy, and likely cause problems for some time.

- **System interconnection**
  There was almost universal agreement that a single e-mail service was the best solution for organisational messaging needs. However, this proved to be very difficult to achieve in practice. Consequently, most organisations have opted to establish an interconnecting (and integrating) e-mail backbone instead.

In contrast to the first hybrid strategy, where bottom-up and top-down strategies are pursued sequentially and contingently, the second hybrid strategy we found integrates the two in a systematic and pre-planned way: bottom-up adoption is steered and controlled through a parallel, overarching, top-down implementation strategy (Jakobs and Lenßen, 1994).

Use of the second hybrid strategy was observed within a large French chemical group. Sales staff and a special communications group were the first to be involved in the project. A simple strategy was adopted: people known be interested in trying and testing new techniques were persuaded to use the new e-mail service. Those people then had something like a catalyst function within their respective departments, serving to promote the further introduction of the system. Messaging could be demonstrated as being an attractive service. It was always made very clear that messaging was not intended to be a replacement of other established communication media, but an additional service, and that messaging would be as easy to use, and at least as effective as other communication services. Stressing these facts was considered crucial, as gaining users' confidence has always been a vital part of the internal marketing strategy.

Eventually, management and other senior personnel learned about the benefits of e-mail, largely by word of mouth. Once these people were enthusiastic about messaging, it became an important tool in their departments within very short time. It turned out that people suddenly found they had various obligations that forced them to use e-mail. In fact, this was simply because colleagues or superiors were using the system. This development was supported by group meetings, where messaging benefits had been presented, with senior staff sharing their related experiences. Such private success stories and experiences, as well as concrete business cases, contributed significantly to the system's further uptake.

This hybrid approach is of particular interest because it represents an attempt to combine the advantages of a pure top-down implementation strategy -- i.e. its speed -- with the advantages of a bottom-up adoption strategy -- i.e. the opportunities for organisational learning -- but without the latter's disadvantages -- i.e. the problems of incompatibility.

END-USER ISSUES

This section discusses the steps taken by the case study organisations to satisfy the needs of their users, and to promote the take up and usage of the e-mail service. Of numerous influential factors (see e.g. Yaverbaum, 1988), the topics addressed include user training, support facilities, and provision of channels to forward complaints, suggestions, problems etc. The latter may be taken as a measure, in part, of users' scope for contributing to subsequent service developments.

User Training And Support Facilities

Attitudes varied with respect to user training. The range of comments included

> *"Full user support on technical issues is provided on site, including user training"*
>
> *"User support enjoys comparably low priority".*

This is quite surprising, given the fact that the importance of user training has long been recognised, (see e.g. Nelson and Cheney, 1987).

The majority of the organisations considered (re)training of users as being of principal importance. In most cases, a substantial amount of time and money has gone into these issues, which include initial training courses for management and support staff; 'training the trainers' being a popular first step. Moreover, staff are employed by some of the organisations to serve in a training role, and to produce specific service documentation.

One company, which insists that staff follow an introductory training courses, considers e-mail as a major (positive) part of today's corporate culture, a view with which staff apparently concur. On the other hand, two companies said that user training is low on their respective priority lists. Although this number is certainly too small to draw any general conclusions, it is nevertheless interesting to note that one of these latter companies sees itself as being "still at an early stage of e-mail use" (after about eight years), with the other admitting that "despite their efforts e-mail is not widely used".

As discussed earlier, the commitment of end-users to their own locally-chosen systems may represent an important barrier when services are integrated and standardised. Some of the case study organisations have realised that forcing users to move from one e-mail system to another is not a good policy. Rather, they have tried to 'persuade' their users to move in the desired direction, by offering, for example, migration tools and better support facilities for the new service, yet whilst retaining (for some interim period) interconnection to the old one.

Despite the different attitudes towards training, the case study organisations are unanimous in their belief that help-desks are crucial to success. In fact, every of them offers access to a help-desk facility to its users, either internally or through a third party.

End-Users and Service Development

The organisations show similarly diverse approaches towards compilation of -- and reaction to -- user reports, suggestions and complaints. Whereas some do have rather sophisticated mechanisms in place for automatic logging of such user input, and have formally established bodies to analyse and react upon these reports, others simply leave it to the help-desk staff. The quality and volume of user input itself seems to reflect the respective approaches: users who know that their comments will be considered seriously appear to be much more willing to actually submit them (Jakobs, 1994).

One of the organisations in the case study has attempted to place users at the centre of policy-making about e-mail services, and is exploiting e-mail as a vehicle for requirements elicitation. A field request logging system is in place through which comments etc. can be sent to a central site where full-time staff are in charge of collating and analysing them. The results are then forwarded to the responsible service manager. A communication user group of about thirty people, drawn primarily from senior management, is responsible for long term service planning. It is within this group that compromises (where necessary) between local and organisation-wide requirements are determined. Recently, the company introduced MIME in response to user demand. Prior to a new product release, both a draft and a total requirements study are performed. So far, staff report that this approach has worked very well.

In contrast, a large proportion of the organisations stated that users have very little, if any, constructive requirements beyond the functionality they are offered. A correlation was apparent between the lack of user feedback and the absence of explicit support mechanisms for conveying and handling it.

Finally, an earlier report on user messaging behaviour within the same group of organisations observed that about four years after the introduction of e-mail, typically some 50% of their users were in a so-called 'bad traffic' zone, i.e. receiving or sending less than one message per day on average (Jakobs and Lenßen, 1994). Most of these 'bad' users commented to the effect that "it is not my fault that the traffic is that bad, there is nobody in the company who is willing to send me a message!". Three years later, ha these once 'bad' users had become 'normal' users, tha they sent or received between 5 to 10 messages per This change was primarily due to better connectivity, better integration of messaging services into the no working environment.

Overall, we found that users within the case s organisations have generally responded positively to introduction of e-mail services, but note that:

- e-mail services will lose their appeal if users do receive 'enough' messages and
- it is important that progress continues to be mad terms of enhanced services.

CONCLUDING REMARKS

The dilemma between centralised, centralised, top-down distributed, bottom-up strategies for system implementa is perhaps unavoidable in the attempts of very large, m divisional organisations to experiment with new evolving technologies. Indeed, it lies at the heart of continuing debate over the management of end-u computing (see e.g. Brancheau and Brown, 1993). Meas to limit experimentation with new technical alternative centralised functions would act as a barrier to innovatio reducing the scope for individual and organisatic learning. This is one of the reasons why large bureaucra in public administration and financial services were m slower than manufacturing organisations in adop distributed computing (Adler and Williams, 19 Management responses to end-user computing have b characterised variously as 'monopolist', 'laissez-faire' 'managed free economy' (Gerrity and Rockart, 1986). evidence of our case studies points to the appa domination of laissez-faire strategies for e-mail ser adoption which, as we have seen, leads to major probl once organisations are forced to grasp the nettle interoperability and system incompatibilities.

Of the alternatives, a better strategy than the monop approach of suppressing locally-generated innovation, m be to develop policies that cater for it, and allow it to fostered within more an overarching strategy. An exa might be the second hybrid strategy revealed in our c studies. More specifically, given the importance compatibility to services like e-mail, it might be usefu encourage local innovations on the condition that the n for migration strategies to eventual organisation standard addressed. This might, for example, involve giv preference to systems built on open standards, includ proprietary industry standards that have been opened ou complementary suppliers, and especially to 'architectural technologies' where some elements of a product remain constant, providing some guarantee of compatibility over several product generations (Morris and Ferguson, 1992).

Technical limits on interoperability constitute one potentially important barrier to such migration. Another barrier, which is arguably more substantial, is the commitment of end-users to their chosen systems and their investment in learning how to use them and adapt them to their working routines. The cumulative investment made by large numbers of organisation members is likely to be large relative to the costs of system acquisition -- as are the costs of transferring from the locally chosen system to the one adopted as the organisation standard. As our case studies show, users can be very reluctant to move from one system to another. Various persuasion tactics were in evidence in our case studies, but results were mixed.

User acceptance will be improved if the transfer to the new system is made relatively painless through the provision of useful migration tools (e.g. allowing users to retain their address directories they have developed; not needing to change existing e-mail addresses, etc.). A natural extension of this approach would be to provide the facility for users to retain the broad look and feel of the user interface (e.g. command language). Though such a proposal may seem difficult to achieve, the network externality benefits of standard user interfaces may themselves result in the widespread adoption of certain industrial standards in this area (Williams, 1993). Ultimately such external standards, for example for Electronic Data Interchange, may provide a template for internal integration and standardisation.

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A Study of User Participation in Standards Setting

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ABSTRACT
This paper explores the views of members of standards setting organisations in the field of electronic communications. It focuses in particular on their experiences of, and attitudes towards, user participation in standards setting.

KEYWORDS: standardisation, e-mail, user requirements

INTRODUCTION AND MOTIVATION
Conventional approaches to the usability of IT privilege the role of design. Elsewhere we have argued for a broader perspective that addresses the whole of the technology life cycle [3]. For example, many important decisions have already been made before designers begin their task. As a result, IT design work increasingly incorporates, and is structured around, standard components which collectively define the technical framework within which design must be accomplished.

In the past, the growing requirement for system interoperability has established the need for standardised communications services. More recently, communications standards have targeted higher level services [4], and the results have direct consequences for usability in application areas such as CSCW. So, the achievement of high levels of IT usability makes it increasingly important to understand how standardisation processes work and, in particular, where they fail to address users' requirements, and why.

This paper presents findings from an ongoing study of standardisation processes in the field of electronic mail. A brief description of the methodology will be followed by a discussion of the major results and preliminary conclusions.

Methodology Interviewees were drawn from the senior membership of ISO (International Organisation for Standardisation) and ITU (International Telecommunications Union) committees, respectively. The survey was done through questionnaires which focussed on:

- views on the standardisation process in general,
- pitfalls of the process and envisaged enhancements,
- problems and benefits of increased user participation.

A total of fourteen responses to the questionnaire, which was distributed via e-mail, have been received so far.

THE STANDARDISATION PROCESS
Both ISO and ITU have established strict formal procedures on how user requirements should be incorporated into the documents. Within ITU, a dedicated Study Group is in charge. According to our respondents, however, user requirements have always been almost exclusively identified by technical people. A committee member admitted:

"I think it would be fair to say that the majority of requirements come from the technical groups."

ISO used to have a similar mechanism in place. Here, Working Group WG1 was responsible, but this was abandoned in the early 1990s. Today, there is a formal procedure requiring [1]:

- the mandatory identification of preliminary user requirements,
- the subsequent agreement on these requirements,
- statements identifying how the standards document conforms to these requirements.

However, our respondents reported that, in practice, requirements are largely made up by the members of the respective technical group, and subsequently approved through this formal process. As one committee member put it:

"There is a formal mechanism, prior to the development of a standardisation project. Sometimes, however, the list of requirements is prepared after the work has started."

About 60% of rapporteurs and project editors come from the service supplier or vendor side, with about 10% from government and 20+% from research institutions [2]. Given these affiliations it is little wonder that a majority of the respondents see themselves as 'company representatives' at the national level, and 'national representatives' at the international level; in fact, of those who see themselves in only one role, 'company representatives' is the one most commonly mentioned. However, quite a few state that they

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also play the role 'user representative'. In the circumstances, it is unsurprising that communication services development has almost exclusively been technology driven; services offered tend to reflect the suppliers' and/or vendors' priorities rather than usability.

"Manufacturers and service providers (including standard's consultants) are the major participants ..." (committee member, 1995).

One of the most interesting findings relates to the main decision- influencing factors. Whilst technical issues dominate, the responses of the committee members reveal that it is non-technical issues which prevail in decision-making. One of the most important single factors is 'presence at meetings', followed by the related matter of 'personality'. Commercial interests are also very prominent. As one respondent put it:

"Company and national group interests are overwhelmingly the greatest factor; less so the reputation of the supporters or opponents than their loudness."

The idea of increased user participation has some advocates amongst the respondents, yet is far from being uncontroversial. Whilst most agree that help in generating and reviewing 'real-world' requirements would be useful, there are also concerns that more people would mean more overheads, more hidden agendas, and maybe even a dilution of expertise available to the committees. In any case, respondents were unanimous that user representatives would need a clear mandate and would be required to work continuously with the respective groups.

"Greater user participation in generating and reviewing the user requirements would be of significant benefit." (committee member, 1995)

Opinions concerning the standardisation process in general are split almost equally between two quite opposite views. One group of respondents used terms like 'cumbersome' and 'over politicised', and hinted at formality, lengthy administrative procedures, participation of unqualified people, and vulnerability to national agendas. The other group stressed the point that decisions are based on consensus, the fact that this lengthy procedure reduces the risk of faulty specifications, and the fairness and openness of the process.

Respondents were in agreement, however, that the standardisation process would benefit from more and better use of available technology. For instance, many hundreds of pages of documents are printed and distributed to committee members before each meeting. Many respondents commented that the use e-mail would significantly streamline information dissemination.

SUMMARY AND CONCLUSIONS

Standardisation is not a simple technical activity but is influenced by political, economic and social factors. With the search for standards that are international, and increasingly comprehensive, standards setting must cater for an ever increasing range of players. Thus, it is little wonder that the formal processes of ISO and ITU tend to be frustratingly slow, and apparently, sometimes highly ineffective.

Although both ISO and ITU have attempted to promote greater user participation in standards setting, our study indicates that this has not been a success. Standards setting within communications services continues to be largely technology driven and supplier or vendor led. As such, the services offered tend to reflect suppliers' and/or vendors' priorities (e.g. manageability) rather than usability. It would seem that the influence of communication service users is limited to the marketplace, where the choices may already be limited. Though this is in keeping with the traditional picture, we believe that this falls far short of the kind of user participation that will be required to address usability issues in the future.

Whilst there is general agreement amongst standards committee members that greater user participation would have beneficial effects, there is also considerable reluctance to press it further. This is understandable, if user participation is pursued within current standards setting procedures and frameworks: an already cumbersome and often ineffective process would become even more so. What is required are new ways of incorporating user input into standards setting processes. Within the past 5 years, almost countless electronic fora (e.g. e-mail distribution services and bulletin boards) devoted to user issues have sprung up on the Internet. The growth in such discussion-oriented services is matched by that of electronic publishing services such as ftp and the World Wide Web. We suggest that standards organisations should look urgently at how the exchange of views and dissemination of information afforded by these services could facilitate greater user participation in standards setting

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Standardisation of Global Telecommunication Services - Expertise or Market Shares?

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Abstract -- Standards are one of the key components of information technology today. Yet, despite their public and widespread implications, the underlying standardisation processes are something of a "black box" to outsiders. This begs the question how standards are determined, and by whom. The paper will look at the lowest, and most technical level of this process, where the basic technological decisions are made. The results of a survey of standards professionals and standards users are presented and analysed. We examine the composition of international committees charged with defining and maintaining standards for electronic mail systems, report the views of senior committee members, including their opinions of the process, how it could be improved, and their reactions to increased user representation. We then present and analyse corporate users' views on participation in standards setting. Finally, the implications of our findings for standards setting are discussed and recommendations made for addressing the problems revealed.

I. INTRODUCTION AND MOTIVATION

Technical standards continue to play a major, if controversial, role in the development of information technology (IT). One particular debate surrounds the question of whether standards actually foster or are an impediment to technological progress and, in the latter case, how standards organisations should respond. Standards organisations face a dilemma, between a pragmatic route of pursuing basic, 'lowest common denominator' standards which can be developed and adopted relatively cheaply and quickly, and embarking upon more long-term development of more complex or more encompassing standards. International standards organisations have often pursued the latter. The desire to please everyone is frequently reflected in attempts to reconcile diverse requirements by allowing a variety of options -- which may lead to systems which conform to the specifications, yet are unable to interoperate [1]. Such time-consuming processes also carry the danger of producing specifications which are quickly rendered virtually obsolete through the failure to consider the latest technical developments. Even worse, slow standardisation is a major obstacle to progress, as systems designers will be reluctant to adopt non-standard solutions [2]. On the other hand, the pragmatic strategy -- i.e. of addressing relatively small standards issues through rather informal working groups -- adopted within other standardisation bodies such as for example the Internet community yields quick results, but may leave a number of standards users unsatisfied because of its somewhat 'patchwork-like' character.

The decision-making procedures followed by standards organisations may also have a significant impact on another important issue -- who are the participants in standards setting and what criteria do they consider in their deliberations? This question is becoming all the more important, as standards are a prerequisite for the global interoperability demanded by the crucial and rapidly growing market for business telecommunications services such as e-mail and electronic data interchange (EDI) and these services, in turn, may have a major influence upon organisational effectiveness and efficiency (see eg. [3, 4]). The increasing reliance of business upon such services raises the question of whether user organisations are able to participate effectively in standards setting processes and thereby to ensure that their requirements will be met. In this paper, we highlight some aspects of this problem, using the standardisation of telecommunication services as an example. It should be noted, however, that the picture presented is very much a European one, and may not hold elsewhere.

Traditionally, development of communication services has almost exclusively been technology driven, with the result that the services offered have tended to reflect the providers' and/or implementors' priorities, like e.g. manageability rather than usability [4]. This can largely be attributed to the fact, despite the very public nature of standards, the relevant standardisation committees have typically been dominated by 'market shares' -- i.e. the major vendors and service providers -- with only token participation by other parties [5].

In the wider arena of IT systems design and development, there is now an acknowledgement of the need to compliment technical knowledge with broader conceptions of relevant expertise -- especially that of users with their knowledge of applications and organisational contexts -- if systems are to meet their goals, and this is reflected in concerted attempts to increase user participation [6].

The goal of our present study is to examine the extent to which the traditional dominance of market shares still holds, or whether the claims that standards setting is becoming progressively user-led are in fact true. Taking electronic messaging services as an example, we report here findings from interviews conducted with members of standardisation committees responsible for messaging standards.

We will take a closer look at standardisation work groups where the actual technical specifications are being produced. We will report, analyse and discuss opinions, ideas, views and speculations of senior members of the relevant technical working groups of major standards setting bodies. This will provide insight into how members of the caste of 'standardisation professionals' see themselves and their roles, and their opinions concerning standards setting processes and procedures. By airing the views of individuals actually involved in the technical part of the standardisation process -- views which are sometimes very different from, and critical of, the official positions and claims of standardisation bodies -- we hope to provide a more realistic and more detailed picture of standards setting processes than the one generally held.

The remainder of the paper is organised as follows: after a brief description of the methodology employed (section II) we discuss the relations between the different stakeholders in the standardisation process (section III). Section IV provides an in-depth description and discussion of the standardisation-related aspects we found most important. This is followed by a discussion on how these findings may help answer the question raised in the title (section V). Finally, we conclude with some recommendations for improving user participation in section VI.

II. METHODOLOGY

The opinions of representatives from standards organisations and user companies were surveyed through questionnaires and face-to-face interviews. The former were drawn from members of relevant committees from ITU (the International Telecommunications Union and ISO (the International Organisation for Standardisation.

With respect to users, the study focused on large, globally operating enterprises, as it was assumed that these would be more likely to be involved in standardisation issues. Membership in user organisations -- e.g. the European Electronic Messaging Association (EEMA) -- was another selection criterion, as it was felt that such membership would be indicative of a higher than average degree of interest in the subject. Eight face-to-face interviews with representatives of large, internationally operating companies from very different sectors, including finance, information brokering, transport, and petro- chemicals. The people selected were senior members of IT departments and also their respective company's EEMA representative.

Typically, interviews lasted between one and three hours, and focused on:

- general experiences of electronic messaging services.
- shortcomings of the systems used, if any, •how such shortcomings were overcome, and •attitudes towards participation in messaging standards committees.

Nine responses to questionnaires and nineteen face-to-face interviews with organisational representatives were analysed.

In addition, interviews were conducted with representatives of three international e-mail service providers. In all cases the interviewees selected were responsible for commercial messaging customers. The topics covered were quite similar to the above.

Interviewees from within standards setting organisations were representatives of

- ISO/IEC JTC1/SC18
  ISO/IEC (International Electrotechnical Commission) Joint Technical Committee 1, Sub-committee 18 is responsible for 'Document Processing and Related Communication', which particularly includes electronic messaging. The prospective respondents were selected from the list of the sub- committee's senior members, i.e. project editors (responsible for writing up the specifications), rapporteurs (group chairpersons), and liaisons (responsible for maintaining links between different committees).

- ITU Study Group VII
  SG VII is in charge of "Data Networks and Open System Communications", which primarily includes all OSI related topics, as well as numbering, addressing and, perhaps more prominent, Message Handling Services and Directory Services (X.400 and X.500 Series of Recommendations, respectively)

As members of the committee are located all around the world, this part of the survey was done through questionnaires. A total of twenty-three responses from standardisation committee members to the questionnaire, which was distributed via e-mail, were analysed.

III. RELATIONS BETWEEN DIFFERENT STAKEHOLDERS

A considerable number of different stakeholders in the electronic messaging arena can be identified. This section will look at the relations between them.

Figure 1 shows the 'ideal' situation, with all stakeholders having a (more or less equal) say in the standards setting process. However, this is far removed from the reality revealed by our case study.

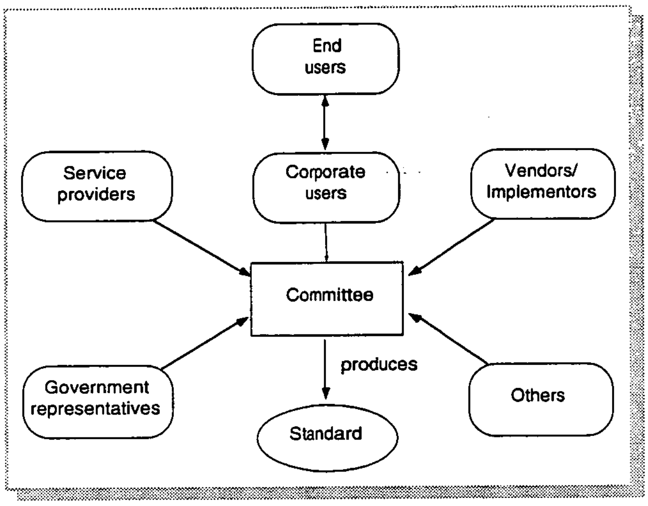

Figure 1: The Idealised Standards Setting Process

All stakeholders are users of standards in one way or another, yet have very different interests. For instance, service providers, vendors can be described as direct users of the standards, that is, they are offering services or products that implement the functionality laid down in the standards documents. On the other hand, corporate users, can be termed indirect users of a standard, as they are not making direct use of the standard as such, but of the services and products sold to them by service providers and vendors.

To some extent, this is reflected in Figure 2, which shows the picture that emerges from our study.

Indeed, it can be concluded that implementors and service providers (deliberately or not) act as a 'buffer' between users and standards committees (the double-arrows in Figure 2).

Whilst this seems to be very advantageous for the users in getting their short-term problems resolved in an ad-hoc manner, this also implies that established processes and procedures are being bypassed for the sake of a quick solution. As a result, one might suspect that at least some user requirements simply do not make it into the standardisation process because of this 'buffering' phenomenon .

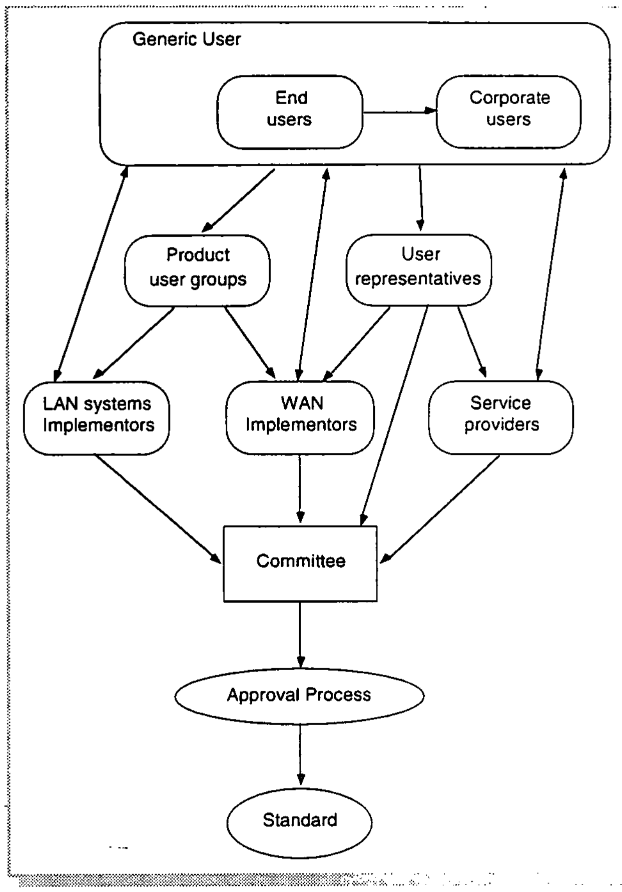

Figure 2: A More Realistic Picture

IV. THE STANDARDS SETTERS' VIEW

In this section, we present a summary of the responses we received to the questionnaire. We begin with a brief description of the respondents.

A. The Formal Procedures

Both major messaging standardisation bodies, ISO/IEC JTC1 and ITU have established strict formal procedures on how user needs and requirements should be incorporated into the standards documents. Within ITU, responsibilities are assigned Study Groups (SGs). At present, fifteen SGs are working actively, covering the entire field of telecommunications. SG7 is, inter alia, responsible for 'Message Handling Systems', i.e. X.400, and SG1 is in charge of producing 'Service Definitions'. In other words, the latter is largely responsible for identifying user requirements. However, ITU recognises the fact that requirements may as well come from other 'technical' groups. In this case, any requirements identified must be sent to SG1 for approval through 'Liaison Statements'. This is a highly formalised process. Reportedly, cooperation between SG7 and SG1 worked reasonably well in the past; they had co-located meetings, and SG 1 didn't really interfere with the technical work. More recently, the co- located meetings have been abandoned, and contact is limited to the exchange of liaison statements. According to our respondents, however, user requirements have always been almost exclusively identified by technical people. An ISO committee member admitted:

> *"I think it would be fair to say that the majority of requirements come from the technical groups."*

ISO/IEC JTC1 sub-committees used to have a similar mechanism in place. Here, Working Group WG1 was in charge, but this was abandoned in the early 1990s.

> *"SC18 made a big show of developing user requirements; it even had a whole working group devoted to the process. I think the effort largely failed because (1) nobody could agree on what a user was, (2) the other WGs tended to look at WG1 (the user requirements group) as an impediment, and (3) when budgets got tight, nobody could afford to send real users to meetings just to oversee a process."* (ISO committee member, 1995).

Today there is a formal procedure requiring (ISO 1995a):

- the identification of preliminary user requirements as a mandatory part of a New Work Item Proposal,
- the subsequent agreement of the relevant sub-committee on these requirements, yielding a set of Agreed User Requirements,
- statements identifying how the standards document conforms to these requirements.

Our respondents reported that, in practice, this results in a process similar to that of ITU. Requirements are made up by the members of the respective technical group, and subsequently approved through some formal process. As one ISO committee member put it:

> *"There is a formal mechanism, prior to the development of a standardisation project. Sometimes, however, the list of requirements is prepared after the work has started."*

What all this comes down to is that user needs are not seriously considered within the Work Groups. As this is the level where the technical specifications -- which establish the basis of all subsequent steps and decisions throughout the whole standards setting process -- are produced, it is tempting to conclude that user needs have no big impact on the final standards.

B. The Committees

1) Committee Members: A closer look at the different representatives' affiliations reveals some interesting facts. In particular, it is safe to say that manufacturers, service providers, carriers and PTTs clearly dominate the committees, at least in terms of numbers.

As far as the ISO/IEC JTC1 is concerned, some 60% of rapporteurs and project editors come from the service provider/vendor side, with about 10% government and 20+% research institutions [7]. Looking at ITU SG7, things appear even more extreme: about 75% service providers, carriers and vendors, and 5-8% each for government, consultants, research institutions, plus some others [8, 9]. However, ITU's origin as a pure PTT organisation can help explain this situation -- it used to be PTTs (and equivalent organisations) only until 1992.

These statistics are not really surprising as they reflect the historical reluctance of telecommunications operators and suppliers towards the involvement of users in standards setting [3].

2) Who Dominates: The survey results made it very clear that manufacturers/vendors of telecommunications equipment, implementors of messaging standards, and messaging service providers/PTTs also dominate the process within both organisations in terms of influence.

> *"Service providers / PTTs are the most numerous and dominant followed by some of the key suppliers. Governments tend to only be involved in the higher level organisational decision making - rarely in the technical work."* (ITU committee member, 1996).

> *"Manufacturers and service providers (including standard's consultants) are the major participants; it is too expensive for small companies and user groups to attend and commit the resources necessary for effective participation (one cannot be effective in standards development and only attend part-time)."* (ISO committee member, 1995).

The latter quote also sheds some light on the crucial financial aspect of standardisation. Even if companies have an interest in participating, they still face the problem of how to fund such activities. This holds primarily for user companies, and even service providers with a vital interest in the subject have been known to reconsider when economic circumstances demand cost-cutting. Indeed, financing the standardisation process has long been an issue (see eg. [10]), and this problem is particularly crucial for organisations which do not see a direct benefit from such activities. The one crucial question to be addressed is 'is this part of our core business?', to which user companies by and large answer 'no'.

There is also another aspect that must not be underestimated -- the role of the individual.

> *"The dominant influence in standards development is the individual (and their sponsoring group) who comes prepared with written contributions, actively participates as an editor, or volunteers to draft responses or contributions at the standards meeting."* (ISO committee member, 1995).

Committees largely dominated by service providers and vendors, and heavily influenced by strong personalities do appear to provide a level playing field for user representatives, whose employers do not normally consider standardisation, or even running their own IT infrastructure as part of their core business.

3) What Counts?: Perhaps the most important question for many participants in the standards setting process may be 'What is the best way to push my proposal?' This, in turn, leads to the question 'What are the main factors influencing technical decisions?' Our survey shows that proponents being present at meetings, and thus being in a position to discuss and defend their ideas - is the strongest single contributor to success, followed by the technical quality of a proposal (something of a pleasant surprise), and company or national interests backing a proposal. A typical comment by an ISO committee member:

> *"Physical presence at the meeting is a very important factor. A technically sound proposal can be rejected if no one of the experts attending a meeting supports it. Company interests also play an important role. In the case of conflicts, it may be necessary to take "diplomatic" decisions, which may lead to technically poor solutions."*

Considerably less important, though still influential, are the respective merits of supporters and opponents, and the fact that a pilot implementation is already available somewhere. It should be noted that 'merit of supporter' and 'company interests' seem to be far more important for ITU than they are for ISO.

C. The Respondents

It seems that there is a caste of 'standards professionals'; the vast majority of respondents have been active in the field for at least seven years in various positions, and some considerably longer. About 60% of the interviewees came from the service provider/vendor side, with about 20% government and some from research institutions and consultancies. In particular, no representative from corporate users was among the respondents.

Given these affiliations it is little wonder that a majority of the respondents see themselves as 'company representatives' at the national level, and 'national representatives' at the international level; in fact, of those who see themselves in only one role, 'company representatives' is the one most commonly mentioned.

> *"By definition when I attend an international meeting, I am a national representative. When I attend a national meeting, I am representing my company. In all cases, one attempts to promote the technical superior solution; however, in the political climate of 1978 - 1995 that has seldom counted for much."* (ISO committee member, 1995).

However, some state that they also take the part of a 'user representative'.

> *"End user representative seeking non-proprietary solutions."* (ITU committee member, 1996).

D. Their Views

We summarize here the (personal) views and opinions of the respondents on various aspects of the standards setting process as perceived by them.

1) The Process in General: Opinions concerning the standardisation process were split between two quite opposite views. The majority of respondents, however, used terms like 'cumbersome' and 'over politicised', and hinted at formality, lengthy administrative procedures, participation of unqualified people, and vulnerability to national agendas. Committee members put it this way:

> *"Cumbersome, slow, redundant, infested with politics and backbiting."*

> *"Until very recently, it [ITU] has been a strongly reactionary force in standardisation. Both ISO and ITU have a rather parochial view of themselves and are fairly out of touch with reality. Recently, ITU*

has shown a greater inclination of getting in touch with reality, but has a very long way to go."

"They start with very technical issues with a lot of input from various sources such as carriers, VANs, manufacturers and so on. But they normally get very political when implementation and marketing starts."

The other group stressed the point that decisions are based on consensus, the fact that this lengthy procedure reduces the risk of faulty specifications, and the fairness and openness of the process.

"Formal processes that produce high quality standards documents which represent a high degree of consensus among the National Body participants." (ISO committee member, 1995).

There was wide agreement about the inherent fairness of the process being at the same time its major weakness.

"Its major strength -- its inherent fairness -- is also its major weakness. To insure fairness, ISO/ITU imposes formality and process. But formality and process impose overhead. The amount of process makes things slow." (ISO committee member, 1995).

2) User Participation: The idea of increased user participation has many advocates amongst the respondents, yet is far from being uncontroversial. There are concerns that more people would mean more overheads, and maybe even a dilution of expertise available to the committees.

".... Users have less idea about what a clean design is or could be than the vendors or PTTs." (ITU committee member, 1996).

"In general, it would not be useful to have users attend standards committees, because users are not knowledgeable about "engineering" solutions." (ITU committee member, 1996).

Moreover, respondents were afraid of hidden agendas, and were clear that user representatives would need a mandate.

"I'm not sure. The pro would be that we would have real data to work from, rather than our expert opinions, thus (potentially) increasing acceptance. The cons are significant: What qualifies a user? EVERYONE has some agenda. How do you keep other organizations (vendors, manufacturers) from influencing user groups (or even creating their own)." (ISO committee member, 1995).

In any case, most respondents agreed that help through generating and reviewing 'real-world' requirements would be useful.

"I personally think it is very valuable (having participated in user requirement standards working groups). Standards processes need continual input on what is needed in the marketplace; user input could help provide that information." (ISO committee member, 1995).

"Yes, I think user participation is an important factor in the development and especially in the maintenance of a standard." (ISO committee member, 1995).

3) Improving the Process: Our respondents came up with suggestions how to establish a more efficient standardisation process, each of which had a number of supporters:

- Streamline the process
  The current process is widely perceived as being too slow and not able to react adequately in a fast moving environment such as information technology. Several suggestions have been made to improve this situation, including better use of electronic communication media, removing fixed schedules to work to, pay editors for their work, introduce reviewing committees. This is largely the way some regional bodies (as e.g. the European Telecommunication Standards Institute, ETSI) are working.

  "Increased speed of publication; rationalisation of ISO and ITU overlap; review translation policy." (ITU committee member, 1996).

- Make documents available free of charge
  At present, obtaining standards documents is a major investment. As the success of the Internet is not least attributed to the fact that its standards are freely available electronically to everyone, a similar move has been suggested for both ITU and ISO, though this would not be without problems.

  "Reduce the cost of standards, at the limit distributing them "freely" on the Internet (WWW or FTP). This is a great debate these days. ISO sees a revenue problem associated with copyright violation." (ISO committee member, 1995).

- Practice what you preach
  Respondents were in agreement that the standardisation process would benefit from more and better use of available technology. For instance, hundreds and hundreds

of pages are still being produced, photocopied and distributed via mail (not e-mail) at each meeting. Surprisingly, although these committees are producing telecommunications standards, use of e-mail is the exception rather than the norm, and even where committee distribution lists exist they are not necessarily used for technical discussions between meetings. It does not really come as a surprise that committee members would love to have electronic means at hand for discussion and distribution of documents. Some respondents also suggested that electronic discussions would help to broaden participation.

"Better use of Internet, web pages, ftp sites, electronic mail, on-line discussion groups, and perhaps even video-teleconferencing. Less use of paper..... So what if someone can't make three meetings a year...? Does that mean that they should be denied a voice in the standards process? That's what happens now, but it's hardly right...." (ISO committee member, 1995).

- Bring in more interested parties

The most interesting suggestion, made by several members from both ISO and ITU despite the widespread ambivalence concerning user participation. In fact, it appears that despite reservations, the need for a broader range of participants is widely recognised.

"One can only wish for representative participation - that is down to companies to enable people to participate. Perhaps better public relations with companies so that companies recognize the benefits of targeted participation in relevant standards groups." (ITU committee member, 1996).

"More time to work, less for talking about it. Qualification of experts. Each group needs subject matter experts and standards experts, and potentially user advocates; NOT just people who have the time to attend. Also, each's expertise needs to be respected at the appropriate times." (ISO committee member, 1995).

V. THE USERS' VIEW

A. Participation in Standards Setting

Overall, the major finding from user interviews was that corporate users, even larger ones with a very favourable attitude towards e- mail, showed little interest in addressing perceived service inadequacies by seeking to influence standards setting. Interviewees typically commented that their companies do not see any business benefits in such activities and are therefore not prepared to spend considerable amounts of money on people travelling to meetings and working on standards committees, which brings the additional costs of people being away from their jobs. Where representatives of corporate users did participate, this appears to be largely based on *"personal initiative plus a supportive director."* (corporate user representative, 1995).

Instead, we found that they look to service providers and vendors to come up with solutions to such problems.

> *"We do talk to our vendors quite a bit, if you like, they're proxies for us.... They probably sit on the committees..... They can say their customers are asking for this... You hope vendors and service providers do actually listen to their customers."* (user representative, 1995).

Given the perception of costly, cumbersome and time consuming 'official' standardisation processes (i.e. those embraced by ISO and ITU), which bring no guarantee of success, this may not be surprising. Moreover, once a problem has been identified, it will definitely be too late to try and solve it through establishing a new, or modifying an existing standard (a process which typically takes years).

Corporate users' strategy for dealing with inadequate or inappropriate functionality in e-mail standards is to circumvent them by applying their own (or those of their service providers) local fixes. This strategy was followed very successfully by at least one of the corporate users in the study. The words of an interviewee provide an effective summary of the corporate view:

> *"I don't think we have any issues. If we did have an issue, we would probably fix the problem ourselves, as we have done with confirmations on the Internet."*

Outsourcing of IT services is another factor which tends to deflect user companies from participation in standards setting. With its IT services being outsourced, a major petrochemical company in our study takes the view that it is outsourcing companies' responsibility to ensure that services provided meet requirements. So, if they use a mail service, they expect the outside world to be able and prepared to interconnect to this service in an acceptable way. In other words, if the service works satisfactorily, that's fine, regardless of whether or not the service is standards-compliant.

B. Perceived Quality of the X.400 Standard

A group of representatives from large, globally operating companies were questioned about observed functional shortcomings of the X.400 standard. We had hoped that the outcome of the study would help us get a better understanding of the flaws suspected to be inherent to the standards setting process. At first glance, however, the results came as a surprise:

Identified shortcomings cover a broad range of issues, including many beyond pure service functionality, and thus beyond the scope of a standards document. In fact, the majority of the requirements are more related to organisational, policy or implementation issues rather than technical problems. Moreover, most of the technical requirements are actually being met by the functionality specified in the X.400 documents; difficulties largely stem from inadequate implementations rather than inadequate standards. At the end of the day, we were left with only one major requirement not being met by the specifications [1].

C. The Pattern of E-Mail Development

The explanation for corporate user indifference to participation in standards setting may lie in current perceptions of e-mail. The prevailing view was that e-mail at present is little more than a convenient new communications medium. In general, the corporate users in our study showed little appreciation of its strategic potential. In particular, few reported that it is employed as part of any business-critical process -- indeed, interviewees revealed that sending business-related information via e-mail is often actively discouraged.

The lack of long-term strategic planning has been a feature of corporate e-mail development throughout its history. In most of our case study organisations, initial take up and diffusion has been end-user led [4]. From a technical stand point, therefore, most have been preoccupied with the very down-to-earth issues that have arisen from a haphazard and uncoordinated pattern of development -- such as providing reasonably smooth interworking between different legacy systems -- as opposed to anticipating future requirements.

Overall, US organisations are more active in standardisation bodies. Given that, in terms of corporate e-mail usage, the US is a couple of years ahead of Europe, we may expect to observe a similar development in Europe in about three to five years time; more data will be needed to substantiate this prediction. As a result, such a development might also trigger greater interest in participation in standards setting, as awareness of the dangers of functional shortcomings in strategic services becomes greater.

VI. CONCLUDING REMARKS

Standardisation is not a simple technical activity but is influenced by political, economic and social factors. With the search for standards that are international, and increasingly comprehensive, standards setting must cater for an ever increasing range of players. Thus, it is little wonder that the formal processes of ISO and ITU tend to be frustratingly slow, and apparently, sometimes highly ineffective. It is little wonder that the dominant perception of users is that they are costly, cumbersome and time consuming and bring no guarantee of success.

Long term planning of e-mail service development is new and reflects the fact that corporate use of electronic messaging has not yet become strategic. Therefore, little additional functionality has been needed so far. In the early stages of a new technology's penetration, users' understanding of their requirements is inevitably limited and so their capacity to contribute to defining standards may be limited at this time. This situation typically changes as user experience of the technology grows, and we would expect this pattern to be repeated in the case of e-mail.

The problems corporate users have identified so far appear to stem largely from inadequate implementations of standards rather than flaws in them. For solutions to these kinds of problem, they naturally turn to system vendors and service providers rather than to standardisation bodies. It is clear that, at least for the day-to-day problems users have had to deal with so far, talking to vendors and service providers is the more practical approach, especially as these problems normally require quick solutions, rather than lengthy strategic planning.

Nevertheless, both ISO and ITU have attempted to promote greater user participation in standards setting. However, our study indicates that this has not been a success. Standards setting, especially within communications services, continues to be largely technology driven and supplier or vendor led. As such, the services offered tend to reflect suppliers' and/or vendors' priorities (e.g. manageability) rather than user friendliness and usability. It would seem that the influence of communication service users is limited to the marketplace, where the choices may already be restricted [3].

This impression of a virtually non-existent influence of users on the standards setting process, at least at Work Group level, is backed not only by sheer numbers - there were no users among the senior committee members interviewed and a negligible number among 'normal' committee members. Moreover, greater user participation would not necessarily be happily welcomed without reservation by all committee members - a finding in some contrast with official statements from all international standardisation bodies (see eg [11])

Whilst there is some agreement amongst standards committee members that greater user participation would have beneficial effects, there is also considerable reluctance to press it further. This is understandable, if user participation is pursued within current standards setting procedures and frameworks; an already cumbersome and often ineffective process would become even more so. Furthermore, the standards professionals primary concern with 'producing a clean design' contrasts with that of users who are more interested in specifying a service that meets their needs. Against this background, it is not really surprising that even large user companies apparently are very reluctant to become actively involved in standardisation.

It is beyond the scope of this present paper to judge whether corporate user participation in standards setting is necessary (or even sufficient) to guarantee their requirements are met, either now or in the future as communications services take on an increasingly strategic role and significance; reliance upon vendors and service suppliers to act as user 'proxies' may continue to produce adequate results. Yet, amongst standards professionals themselves there is evident disquiet about the lack of user participation. Underlying this, perhaps is a concern that standards setting should be seen to be fair, and we would argue that this, in itself, is sufficient reason to prompt consideration of how user participation might be increased.

In his study of standards setting in digital wireless telephony, Hawkins observes that though costs of participation are usually cited as the principal barrier, these are often symptomatic of more fundamental problems which reflect the diverse and fragmentary nature of the user community and their problems of establishing a common view, and that this is in sharp contrast with the generally more overlapping interests and common focus of vendors and service providers [3]. Even where users seek representation through user groups (e.g. EEMA), the determination, authorisation and presentation of a user position remains problematic.

One possible solution to these structural impediments to user participation would be to provide new 'lightweight' forms of participation in standards setting processes which reduce the overheads and allow both individual and collective views to put over more easily. Within the past five years, numerous e-mail distribution services and bulletin boards, as well as publishing services (e.g. ftp and the World Wide Web) have sprung up on the Internet. We suggest -- in line with the views of many standards professionals -- that standards organisations should look urgently at how the exchange of views and dissemination of information enabled by these services could open up standards decision-making and help to counterbalance the continuing dominance of market shares over broader conceptions of expertise.

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ELECTRONIC MESSAGING - THE LIFELINE OF THE GLOBAL ENTERPRISE

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ABSTRACT

This paper raises some of the issues related to large corporate e-mail systems. A brief discussion of whether or not current functionality suffices is given first. The result of this discussion is then related to the development of corporate e-mail systems. We show that a number of problems typically experienced stem from a lack of early strategic thinking. Subsequently, end-user problems of messaging services are discussed, including user training and support and mechanisms in place allowing end-users to forward complaints and suggestions. This is followed by a brief analysis of e-mail's organizational impact.

MOTIVATION

Electronic mail has made its way into the offices of virtually all large international organizations. However, for distributed IT systems such as e-mail, two kinds of barriers to successful implementation may be particularly important. The one most commonly recognized is caused by differences between various proprietary solutions or different generations of technology, which may mean that systems cannot interoperate or that some functions cannot be shared. Another, potentially more significant barrier arises from the commitment of end-users to their own locally-chosen systems - which may represent a substantial investment made by large numbers of people in learning how to use a system and to apply its functionality to their working activities.

We explore these and other, related issues through a number of case studies on the adoption and development of e-mail services in large, international organizations in a variety of different business sectors including finance, chemistry, aviation, and oil.

DOES FUNCTIONALITY MATTER?

When attempting to identify the constituents of a usable, useful and therefore successful corporate e-mail system, functionality is one of the potential contributors that springs to mind. This is supported by the frequent complaints about the insufficient number of users participating in the standardization process (cf eg. (ETSI 1992) or (Hawkins 1995)). Standards - and thus systems - that cannot survive in the market since they do not reflect users' needs are often feared to be the result of this reluctance.

Primarily the European companies represented in our studies did not come up with a big list of additional functionalities they would like. The list of requirements most prominently featured more user-friendly addressing, which was unanimously declared a 'pain in the neck', followed by notification services, enhanced security features, understandable and uniform error messages, multimedia messaging, and simpler editing of messages.

Given that X.400 is the corporate e-mail backbone of choice in Europe, the only item from this list that is neither actually met by the standards' specification (as eg 'notification') or rather beyond the scope of a standard (as eg 'error messages') is 'addressing'. It may therefore be stated that:

- the list of additional functionalities required is surprisingly short,
- most problems appear to stem from inadequate implementations, and thus
- the standard in question is not that bad after all.

This result may come as a (pleasant) surprise. The explanation, however, qualifies the amazement. So far, e-mail has been little more than a convenient interpersonal communication system. In particular, it has not yet become part of any business processes; and there are virtually no mail-enabled applications in use. Judging by the outcome of studies of US-based organizations this will change in the near future. This change, in turn, is likely to yield a considerable number of additional requirements (Jakobs et al. 1996). Therefore, our recommendations for corporate users are

- try and push service providers/implementors to provide full implementations of the standards,

- participate in standardization activities to ensure that future demands will be met.

Trying to explain why apparently nobody has cared about future developments so far, we note that for quite some time other, more down-to-earth e-mail related issues had to have higher priorities (like eg. providing reasonably smooth interworking between different systems). This is primarily due to the development of e-mail in multinational organizations. The next section will elaborate on these issues.

INTRODUCTION STRATEGIES

The issue of corporate IT strategies has been one of growing concern in recent years as IT has become increasingly identified with competitive advantage (Fincham et al, 1994). Boynton and Zmud (Boynton and Zmud, 1987) summarised the options available to corporate managers as follows:

"Will these strategies be driven by environmental forces, ... by chance events? ... or by a coordinated sequence of events? Will these strategies be initiated by a proactive IS function? ... by senior management? ... by subunit management? ... or by a carefully orchestrated network of influential and IT-knowledgeable managers located throughout the organization?"

We will outline and discuss the different approaches employed and hope to contribute to a better understanding of a crucial part of an overall IT strategy - the approaches adopted for introducing technological innovations into the company.

The Top-Down Approach

This is a straightforward approach with the advantage that once decided upon, the introduction of the service is backed by senior management, and thus progresses rather smoothly. Compatibility issues can be solved more easily and a solution providing homogeneous services throughout the whole organization will be much more cost-effective. However, one problem with top-down strategies is that they may be subject to resistance from within the organization. This was the experience of one of our case study organizations, where the introduction of e-mail was initially confounded by people's resistance to change, itself linked to the fact that at that time e-mail's benefits were not really understood. This has changed dramatically over time. It should, however, be noted that the 'top-down' approach rarely occurs in multinationals.

The Bottom-Up Approach

Our study suggests that overall strategic decisions concerning messaging services are not normally made at the very beginning of e-mail penetrating the company. Rather, we found that the initial IT-related decisions were made at departmental or site level. This result may partly be explained by the structure of the case study organizations, the majority of which are subdivided into a number of almost autonomous companies or branches, located around the globe.

The following introduction 'strategy' holds for about two thirds of the organizations within the case study. A group of employees obtains a messaging tool, maybe to fulfil a specific work requirement, or perhaps bundled in with other software. The new service soon becomes popular. Slowly, mainly by word of mouth, information about benefits provided spread throughout the department. The number of users increases steadily, though still within the department or site, rather than at the organizational level. However, at the same time very similar developments take place at many sites, resulting in an extremely heterogeneous environment.

Subsequently, at some point, a central entity takes over and tries to harmonize the different services with management backing. This stage also marks the transition from an almost purely 'technical' approach (ie largely concerned with providing a solution to day-to-day problems) to a higher degree of strategic thinking (ie the realization of the corporate importance of an organization-wide electronic mail system). However, technical problems such as eg. providing and maintaining systems interconnection and smooth interworking still prevail.

Also at this stage most organizations start looking at more flexible and feature-rich systems. In contrast to the initial service introduction, this move has always been part of an overall IT strategy. However, some more strategic thinking during these earlier stages of the development would have saved considerable trouble.

It should be noted here that this approach very much resembles the way LANs were introduced a few years earlier. To some extent this justifies the fear that similar mistakes will be made in the future if and when other new 'distributed' IT systems are to be introduced.

The third step, which many of the organizations interviewed are currently pursuing, is characterized by the introduction of a uniform local e-mail environment, interconnected through a messaging backbone which also offers access to the outside world. Completion of this step means that a homogeneous service will be available for most, if not all, users, and that the number of different gateways will be minimized.

"Until we've got to the stage we've got an entire user population on one e-mail system we're going to have a degree of user annoyance."

END-USER RELATED TOPICS

This section discusses two issues that appear to be crucial for success of failure of a corporate e-mail system.

User Training And Support Facilities

Attitudes varied with respect to user training. The range of comments included

"Full user support on technical issues is provided on site, including user training"

"User support enjoys comparably low priority".

The latter is quite surprising, given the fact that the importance of user training has long been recognized, cf eg (Nelson and Cheney, 1987).

The majority of the organizations considered (re)training of users as being of principal importance. In most cases, a substantial amount of time and money has gone into these issues, which include initial training courses for management and support staff; 'training the trainers' being a popular first step.

One company, which insists that staff follow an introductory training course, considers e-mail as a major (positive) part of today's corporate culture, a view with which staff apparently concur. On the other hand, two companies said that user training is low on their respective priority lists; one of which sees itself as being *"still at an early stage of e-mail use"* (after about eight years), with the other admitting that *"despite our efforts e-mail is not widely used"*

Some of the case study organizations have realized that forcing users to move from one e-mail system to another is not a good policy. Rather, they have tried to 'persuade' their users to move in the desired direction, by offering, for example, migration tools and better support facilities for the new service, yet whilst retaining (for some interim period) interconnection to the old one.

Despite the different attitudes towards training, the case study organizations are unanimous in their belief that help-desks are crucial to success. In fact, every of them offers access to a help-desk facility to its users.

Reacting to User Comments

The organizations show similarly diverse approaches towards compilation of - and reaction to - user reports, suggestions and complaints. Whereas some do have sophisticated mechanisms in place for automatic logging of such user input, and have formally established bodies to analyze and react upon these reports, others simply leave it to the help-desk staff. The quality and volume of user input itself seems to reflect the respective approaches: users who know that their comments will be considered seriously appear to be much more willing to actually submit them (Jakobs et al. 1995).

Overall, we find that users within the case study organizations have generally responded positively to the introduction of e-mail services, but note that:

- e-mail services will lose their appeal if people do not receive 'enough' messages and

- it is important that progress continues to be made in terms of enhanced services.

ORGANIZATIONAL ISSUES

This section very briefly addresses general organizational issues related to e-mail.

Some of the interviewees acknowledged that e-mail had at least contributed to organizational changes. The most prominent effect reported was that it had helped to create a flatter hierarchy, with complete management levels having vanished following its introduction. It should, however, be noted that e-mail was seen as being only a facilitator of this trend, and not its prime cause. Interviewees generally agreed that success in achieving a flatter hierarchy could be largely be attributed to the newly gained ease of communication with senior management. They also agreed that organizational downsizing had increased the importance of e-mail.

It was reported by more than one interviewee that e-mail had also been an important factor behind decisions to establish spin-off companies. E-mail was seen as the means to reconcile the goal of tackling niche markets more efficiently whilst maintaining close (communication) links between the spin-off company and its parent.

On the more external side, e-mail was said to have provided more efficient communication with business partners, and even to have helped forge new business partnerships.

Finally, numerous case study organizations envisaged e-mail enable teleworking to a greater extent, a fact that may well contribute to extremely significant organizational changes in the future.

SUMMARY AND CONCLUDING REMARKS

Electronic mail has been introduced by an ever growing number of organizations. Whilst this does not necessarily guarantee any improvements for the company in itself, it provides a means to generate real business benefits. Usefulness will be raised further once e-mail has become an integral part of the business process. Once this has happened, it will imply a range of additional functional requirements to current standards specifications.

End-user reactions to e-mail seems generally to be very positive, even though it is widely perceived as an important facilitator of corporate restructuring. This aspect of corporate e-mail services may yet lead to a less favourable reaction amongst end-users if downsizing trends continue.

An introduction strategy that incorporates requirements analysis, training of users well in advance, and appropriately reacting to user feedback are major cornerstones of a successful corporate e-mail service. An e-mail service which is not at odds with established working procedures and which is to be used by well-trained employees, is most likely to leave both, employer and staff satisfied. Above all, adequate training appears to be crucial for a successful uptake of e-mail services.

Finally, to answer the question of how companies have chosen to approach the introduction of e-mail services, we found that it is largely subunit management that triggered the adoption of e-mail. Only in a very few cases have we found that the development was initiated by senior management. Subsequent stages of e-mail use reveal the use of a more centrally planned approach as its strategic value becomes evident.

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Users and Standardization—Worlds Apart? The Example of Electronic Mail

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We report on and analyze the views of long-standing active members of standards-setting working groups in electronic communications. We focus in particular on their experiences of, and attitudes towards, user participation in standardization. The results reveal attitudes that differ considerably from the official statements. To complement the views of standards professionals, we explore the attitude of large corporate email users towards standardization in general, the impact standards have on their choice of corporate systems, and their apparent reluctance to play an active role in standardization. This includes a closer look at the ways in which email has emerged in organizations, and on what corporate users actually expect email to offer. A typical pattern can be identified, which in turn helps explain the reluctance of corporate users to actively participate in standards setting. Finally, we consider the implications of this and conclude with some recommendations on how the current situation could be improved.

Information technology (IT) has been a critical resource for business organizations for many years. The ways in which IT is used has changed dramatically, however, since its introduction as a rationalizing tool, employed mainly as a means to increase the productivity of clerical workers [Fincham et al. 1994].

IT is increasingly assuming a strategic role for business, and nowhere is this better illustrated than by the rapid growth of computer-based electronic data communication services.

Over the last ten or so years, three crucial trends—integration, internationalization, and cooperation—resulted in the need for global, unambiguous, and adequate standards for communication services. These trends reflect the general move towards increased globalization.

One of the major developments in IT reflecting these trends was the move from proprietary communication systems—almost exclusively employed until the mid-eighties—towards "open" systems, i.e., TCP/IP- or OSI-based communication networks. However, this was only the first step towards globally homogeneous, useful, and usable communication services. Interoperability between the different communication worlds remains the major issue in this context.

More recently, a shift to distributed applications has taken place (as exemplified by groupware and other mail-enabled applications). One consequence of this shift is an ever-growing demand for interoperability, and hence for standardized communications services. We argue that standards are becoming increasingly important, especially in the case of distributed applications, but also more generally as systems development increasingly incorporates, and is structured around, standard components and tools. To some extent, design is steadily taking on the character of mere standards implementation.

It is clearly desirable that standards do not constrain the designer's freedom to address the respective local context, particularly the local user commu-

...design is steadily taking on the character of mere standards implementation.

nity's requirements. However, there is a tension between a standard's inherent goal of catering for generic functionality and the designer's need for maintaining flexibility to deal with local variability. This is particularly acute in distributed applications where a framework of communication standards strongly biases actual design considerations.

So it becomes even more important to understand how standardization processes work and, in particular, where they fail to address user requirements, and why. These are matters of crucial importance to users. But there is comparatively little discussion, let alone experience, of how users might participate in standards-setting [Salter 1993]—particularly for standards related to communication services.

Standardization is not a simple technical activity but is influenced by political, economic, and administrative factors. With the search for standards that are international, and increasingly comprehensive, standard setting must cater to an ever-increasing range of players. It is little wonder that the formal standards-setting processes of, for example, the International Organization for Standardization (ISO) and the International Telecommunication Union (ITU) tend to be extremely slow. Moreover, given the diversity of contexts, formal standards organizations face a dilemma between a pragmatic route of pursuing basic, "lowest common denominator" standards, which can be developed and adopted relatively cheaply and quickly, and embarking upon long-term development of more complex or more encompassing standards [Fleck 1993]. International standards organizations often pursue the latter. Though this holds out the hope of more advanced standards, in practice it frequently results in unduly complex specifications that prove extremely difficult to implement, maintain, and manage. Moreover, the desire to please everyone is often reflected in attempts to reconcile diverse requirements by allowing a variety of options, which may lead to systems that conform to the specifications, yet are unable to interoperate [Graham et al. 1995]. Such time-consuming processes also carry the danger of producing specifications that are quickly rendered virtually obsolete through failure to consider the latest technical developments. Even worse, slow standardization is a major obstacle to progress, as systems designers will be reluctant to adopt nonstandard solutions [Fleck 1993]. On the other hand, the pragmatic strategy adopted within standardization bodies such as the Internet community (i.e., to address relatively small standards issues through rather informal working groups) yields quick results, but may leave a number of standards users unsatisfied because of its somewhat "patchwork-like" character.

So far development of communication services has almost exclusively been technology-driven; services offered tend to reflect the providers' and/or implementers' priorities, like, for example, manageability rather than usability. This can largely be attributed to the fact that relevant standardization committees have typically been dominated by vendors and service providers, with only the very occasional representative of a corporate user [Cargill 1989].

We explore the issues and problems of user participation in standards-setting through a case study in electronic messaging services. We report the findings from interviews conducted with both representatives of a number of large (European-based) corporate users of electronic mail services and with members of the standardization committees responsible for messaging-related standards.

The case study is described in more detail in the next section. The sections that follow present and analyze the current state of user participation in messaging standards-setting as revealed through the views of standards setters and users. Finally, we consider the prospects of user participation in the future and the implications this holds for standards-setting processes.

THE EMAIL CASE STUDY

Email was selected for our case study because it is by far the most popular communication service, utilized by an ever-increasing number of users with diverse backgrounds and expectations of what messaging should do. Here, at least, we might expect to find exemplars of usability. However, a number of studies suggest that these services often fail to live up to users' expectations [Jakobs and Lenssen 1994; Jakobs et al. 1995a; Procter and Williams 1996].

Defining the User. The concept of the "user" is becoming progressively more complex: an ISO working group charged with identifying user requirements reportedly failed, and the effort abandoned in the early 1990s, largely because they could not come up with a meaningful, and agreed, definition of what constitutes a "user." Typically, the term is employed in very different contexts with very different meanings. A user of an email service, for instance, may be a corporate user (e.g., a company or a government agency), or an actual end-user; a user may also be a system administrator or an application (e.g., Electronic Data Interchange, EDI). These services are provided by implementers and service providers, respectively. Thus, this group is also made up of users, but of a standard specification, as opposed to a service. We employ the term "user" synonymously with "corporate user," unless stated otherwise.

Methodology. The opinions of representatives of corporate users and standards organizations were surveyed using both semistructured interviews and questionnaires. With respect to users, the study focused on large, global enterprises, as it was assumed that they would be more interested in standardization issues. Membership in user organizations—e.g., the (European) Electronic Messaging Association ((E)EMA)—was another selection criterion, because such membership reflects a higher than average degree of interest in the subject. Thirty interviews (either face-to-face or through emailed questionnaires) were conducted with representatives of large, international companies from very different sectors, including finance, information brokering, transport, and petrochemicals. The people selected were senior members of IT departments and also the representatives of their respective companies within (E)EMA.

Typically, interviews focused on general experiences of electronic mail services; shortcomings of the systems used, if any; how such shortcomings were overcome; and attitudes towards participation in messaging standards committees.

In addition, interviews were conducted with representatives of three international email service providers. In all cases the interviewees selected were responsible for commercial messaging customers. The topics covered were quite similar to the above, but this time they referred to the respective customers rather than to the service provider companies.

Interviewees from within standards-setting organizations were all representatives of the ISO International Electrotechnical Commission Joint Technical Committee 1, Subcommittee 18 (JTC1/SC18), or of the International Telecommunications Union Study Group 7 (ITU SG7). The former is responsible for "document processing and related communication," which includes electronic mail, the latter is in charge of questions related to "data networks and open system communications," again including electronic mail. The prospective respondents were selected from the group's senior members, i.e., project editors (responsible for writing up the specifications), rapporteurs (group chairpersons), and liaisons (responsible for maintaining links between different committees). As members of the committees are located all around the world, this part of the survey was done through questionnaires only. The questionnaire focused on views on the standardization process in general; pitfalls of the process and envisaged enhancements; and problems and benefits of increased user participation.

A total of 27 responses to the questionnaire, which was also distributed via email, were received.

THE STANDARDS SETTERS' VIEW

We present a summary of the views and impressions provided by standards committee members who responded to the questionnaire. We begin with an overview of the formal process adopted to ensure that user requirements are adequately considered.

Both major messaging standardization bodies, ISO/IEC JTC1 and ITU, have established strict formal procedures on how user requirements should be incorporated into the documents. Within ITU, responsibilities are assigned to study groups (SGs). At present, 14 SGs are working actively, covering the entire field of telecommunications. SG7 is, inter alia, responsible for "message handling systems," i.e., X.400. "SG1 was in charge of producing 'service definitions'. In other words, this group was largely responsible for identifying user requirements. However, ITU has always recognized that requirements could as well come from other 'technical' groups. In this case, requirements identified had to be sent to SG1 for approval through 'Liaison Statements.' This was a highly formalized process. Reportedly, cooperation between SG7 and SG1 had worked reasonably well in the past; they had colocated meetings, and SG1 didn't really interfere with the technical work. More recently, the colocated meetings stopped, and contact was limited to the exchange of liaison statements. Finally, SG1 was abandoned in 1996." According to our respondents, however, user requirements have always been almost exclusively identified by technical people. A committee member admitted: "I think it would be fair to say that the majority of requirements come from the technical groups." JTC1 subcommittees used to have a similar mechanism in place. Here, Working Group WG1 was in charge, but this was abandoned in the early 1990s.

"SC18 made a big show of developing user requirements; it even had a whole working group devoted to the process. I think the effort largely failed because (1) nobody could agree on what a user was; (2) the other WGs tended to look at WG1 (the user requirements group) as an impediment, and (3) when budgets got tight, nobody could afford to send real users to meetings just to oversee a process." (Committee member, 1995).

Today, there is a formal procedure [SC18.1995a] requiring that:

- the identification of preliminary user requirements be a mandatory part of a New Work Item Proposal;
- the subsequent agreement of the relevant subcommittee on these requirements yield a set of Agreed User Requirements; and
- the statements identify how the standards document conforms to these requirements.

Our respondents reported that, in practice, this results in a process similar to that of ITU. Requirements are made up by the members of the respective technical group, and subsequently approved through some formal process. As one committee member put it: "There is a formal mechanism, prior to the development of a standardization project. Sometimes, however, the list of requirements is prepared after the work has started."

At least among project editors, there is a caste of "standards professionals," the vast majority of whom have been active in the field for at least seven years in various positions, and some considerably longer. Moreover, about 60% of rapporteurs and project editors come from the service provider/vendor side, with about 10% government and 20+% research institutions [SC18. 1995b]. Given these affiliations, it is little wonder that a (slight) majority of the respondents see themselves as company representatives at the national level, and national representatives at the international level; in fact, of those who see themselves in only one role, "company representative" is the one most commonly mentioned. However, quite a few state that they also take the part of a "user representative."

"Company representative at the national level, USA National representative at the international level, and AFII Professional Association liaison at the national and international levels." (Committee member, 1995).

Opinions concerning the standardization process were split almost equally between two quite opposite views. One group of respondents used terms like "cumbersome" and "overly politicized," and hinted at formality, lengthy administrative procedures, participation of unqualified people, and vulnerability to national agendas. Two committee members put it this way: "Cumbersome, slow, redundant, infested with politics and backbiting." And, "I find the whole process rather cumbersome and too rigid. In some areas of standardization this may be appropriate, but in certain topics of information technology more flexibility would be desirable."

The other group stressed the point that decisions are based on consensus, the fact that this lengthy procedure reduces the risk of faulty specifications, and the fairness and openness of the process. "Formal processes that produce high quality standards documents which represent a high degree of consensus among the National Body participants." (Committee member, 1995).

Respondents were in agreement, however, that the standardization process would benefit from more and better use of available technology. For instance, hundreds and hundreds of pages of documents are still being produced, photocopied, and distributed via mail (not email) at each meeting. Surprisingly, although these committees are working on telecommunications standards, use of email is the exception rather than the norm, and even where committee distribution lists exist they are not necessarily used for technical discussions between meetings. It does not really come as a surprise that committee members would love to have electronic means at hand for discussion and distribution of documents. Some respondents also suggested that electronic discussions would help to broaden participation.

The idea of increased user participation has some advocates among the respondents, yet is far from being uncontroversial. While most agree that help through generating and reviewing real-world requirements would be useful, there are also concerns that more people would mean more overheads, more hidden agendas, and maybe even a dilution of expertise. In any case, respondents were unanimous that user representatives would need a clear mandate and would be required to work continuously with the respective groups. "Greater user participation in generating and reviewing the user requirements would be of significant benefit." (Committee member, 1995)

THE USER VIEW

Overall, the major finding from user interviews was that corporate users, even larger ones with a very favorable attitude towards email, showed little interest in addressing perceived service inadequacies by seeking to influence standards-setting [Jakobs et al. 1996a]. Instead, we found that corporate users look to service providers and vendors to come up with solutions to such problems. Interviewees typically commented that their companies do not see any business benefits in such activities and are therefore not prepared to spend considerable amounts of money on people traveling to meetings and working on standards committees. Where representatives of corporate users did participate in standardization, this appeared to be largely based on "personal initiative plus a supportive director." (Corporate user representative, 1995).

There are a number of factors that might explain this result. One is the current corporate perception of email. Of the large number of mail-enabled applications available, only a handful were represented among the corporate users in our study; of these, interpersonal messaging was unanimously identified as the single most important email application. Within our sample, email at present is little more than a very convenient new communications medium. In particular, it is not yet widely employed as part of any business-critical processes, and so far is not perceived as having real strategic significance.

Indeed, interviewees reported that sending business-related information via email is discouraged in almost all the companies in the study. Another important factor underlying current attitudes towards participation in standardization is the way in which corporate email services have developed (see below).

Standards vs. Implementation. One further factor may contribute to the reluctance to participate in standards setting: the vast majority of functional shortcomings, flaws, and problems identified by interviewees stemmed from poor implementation of standards, rather than inadequate standards per se.

The shortcomings and problems cited most often include addressing, notifications (an indication that a message has been delivered to, or received by, the addressee), security, transmission of binary files, and more comfortable editing facilities. From these, the only one truly related to a deficiency in a standard is addressed in X.400. Apart from this, the others merely emphasize that current implementations of messaging standards are less than satisfactory. This holds for X.400, and to a lesser extent for the Internet as well.

X.400 provides for a number of different notifications, including "delivery notifications" and "receipt notification request indications." Many security features have been specified as well, designed to cope with (among others) problems of masquerading, modification of information, repudiation, and leakage of information. Again, the problem is that these are rarely implemented. Transmission of binary files represents a major problem to some Internet users for similar reasons.

In the light of the above, it seems understandable that a corporate user would rather persuade a vendor to offer a full implementation of a standard in the first place, than go to great lengths and push additional functionality into a standard specification. This holds all the more since none of the interviewees reported pressure from end-users for functionality beyond what is currently being provided (typically apart from local implementation details), and none of the service providers has yet been confronted with user requirements beyond X.400's functionality.

The Development of Corporate Email Services: The picture of corporate email service development presented by the interviewees corroborated other studies in this area [Jakobs and Lenssen 1994; Jakobs and Fichtner 1995], and reflects what (at least in its initial stages) is an essentially bottom-up process of diffusion [Jakobs et al. 1996a]. Initially, email use begins when a group of employees happens to obtain a messaging tool, which may come as part of word processing package or be integrated with a new operating system. The new service soon becomes popular with its users. Slowly, mainly by word of mouth, information about the benefits provided by the new messaging service spreads throughout the whole department. The number of users increases steadily. In larger organizations, email usage does not develop at the organizational level. Instead, very similar developments take place at many sites, resulting in an extremely heterogeneous environment.

"Initially the systems were desperate—many various islands, not connected in any fashion. Each of these systems also offered unique qualities for the users. One, for example, was for foreign travel arrangements, another was used widely by secretaries for mass mailing. Still each UNIX workstation offered desktop mail. As more noncomputer users wanted email, we saw the emergence of cc:mail. And then with the introduction of groupware and integrated office products, Microsoft mail became an interest. If we had been able to select a system, the integration of email would have been a breeze. The various systems are still the reason for most of the problems." (Corporate user representative, 1995).

The second stage is characterized by responsibility being taken over by a central department, and focuses on the integration of the typically extremely heterogeneous environment that has emerged so far. This integration is required primarily because of system incompatibilities, causing possibly severe degradation of the enterprise-wide communication quality, which, in turn, may be very costly and frustrating for users. The most common approaches to this problem have either been point-to-point gateways between pairs of systems or, the (rather more common) establishment of a single, company-wide backbone. Alternatively, point-to-point gateways were succeeded by a single backbone. Problems encountered during this stage include compatibility with the existing legacy systems, and maintaining a considerable number of gateways. Unfortunately, this still does not achieve a homogeneous email service, as some local systems provide services that others do not. As one interviewee put it: "Until we've got to the stage where we've got an entire user population on one email system, we're going to have a degree of user annoyance."

The third stage, which many of the organizations interviewed are currently pursuing, is characterized by the introduction of a uniform local email environment (e.g., MS-Mail or cc:Mail), interconnected through a messaging backbone (typically an X.400-based system or the Internet), which also offers access to the respective other email worlds (i.e., the Internet or X.400). Completion of this step means that a homogeneous service will be available for most users, and that the number of different gateways will be minimized.

The important question for this study is why, and at which point, corporate users might have had an interest in getting involved in email standardization. Interviewees noted that there was little motivation to do so during the first stage, when the service was new and requirements not fully understood. Moreover, as there was no central entity involved at this stage, experience and expertise was likely to be distributed across several sites, with none having sufficient to warrant involvement in standardization. While longer term strategic thinking started at the second stage, it was still very much concerned with the question of what should be used for this backbone, whether it should be a proprietary product, an X.400-based system, or the Internet. That is, the question still to be decided was still very much "which product or service suits me best?"

"Do we have an organization-wide email strategy? Yes, we do, and they're called MS-mail and Microsoft Exchange" (Corporate user representative, 1995). In particular, no indication was given by interviewees that activities at this stage should include participation in the standards-setting process to ensure adequate functionality of future services. Interviewees generally confirmed that only now, as corporate users grapple with the third stage and are discovering whether systems really meet their needs, is participation in standards-setting possibly becoming an issue.

RELATIONS BETWEEN DIFFERENT STAKEHOLDERS

A large number of different stakeholders in the electronic-messaging arena can be identified, all of whom are users of standards in one way or another, yet have very different interests (see Figure One). They include end-users, corporate users, service providers, vendors and government representatives. On the assumption that each group would participate on an equal basis, the make up of standards committees would be as depicted in Figure One. However, the picture that emerges from the case study is quite different (see Figure Two).

It seems that users consider that the most effective and convenient way for getting improved systems is to talk to their system vendors and/or service providers, and to buy products that meet their immediate needs [Alexander 1995].

"We do talk to our vendors quite a bit, if you like, they're proxies for us.... They probably sit on the committees.... They can say their customers are asking for this... You hope the vendors and service providers do actually listen to their customers." (Corporate user representative, 1995).

Given the perception of costly, cumbersome, and time-consuming "official" standardization processes (i.e., those embraced by ISO and ITU), which bring no guarantee of success, this may not be surprising. Moreover, once a problem has been identified, it will definitely be too late to try and solve it through establishing a new, or modifying an existing, standard (a process which typically takes years).

Indeed, it could be concluded that implementers and service providers (deliberately or not) act as a "buffer" between users and standards committees (the double-arrows in Figure Two). Helping their customers (users) to resolve short-term problems in an ad hoc manner implies that established processes and procedures are being bypassed for the sake of a quick solution. As a result, one might suspect that at least some user requirements simply do not make it into the standardization process because of this "buffering" phenomenon.

The approach outlined above—to put more functionality into the local system (the User Agent) in an attempt to circumvent inappropriate functionality of the underlying mail system—has reportedly been adopted very successfully by one of the corporate users in the study. In the words of an interviewee: "I don't think we have any issues. If we did have an issue, we would probably fix the problem ourselves, as we have done with confirmations on the Internet."

This is also one of the developments envisaged by one of the large service providers, which sees future very high-level communication services being based on peer-to-peer arrangements rather than globally agreed standards. It remains to be seen if this will really happen. If it does, in our view it will be a step in the wrong direction, and it will also put a big question mark behind the standardization process as such.

As noted earlier, most organizations are using LAN-based email systems as their front-ends and only use X.400 or the Internet to interconnect these local net-

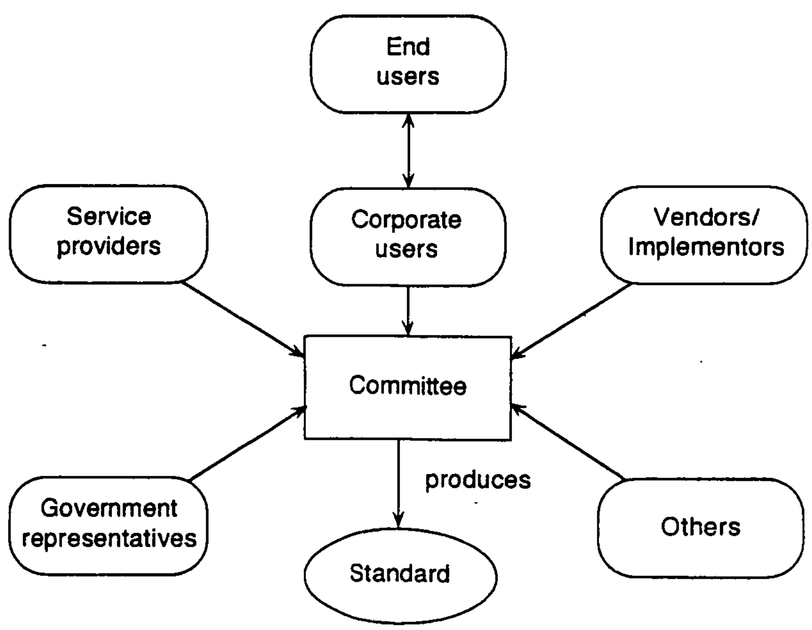

FIGURE ONE.
The ideal standards-setting process.

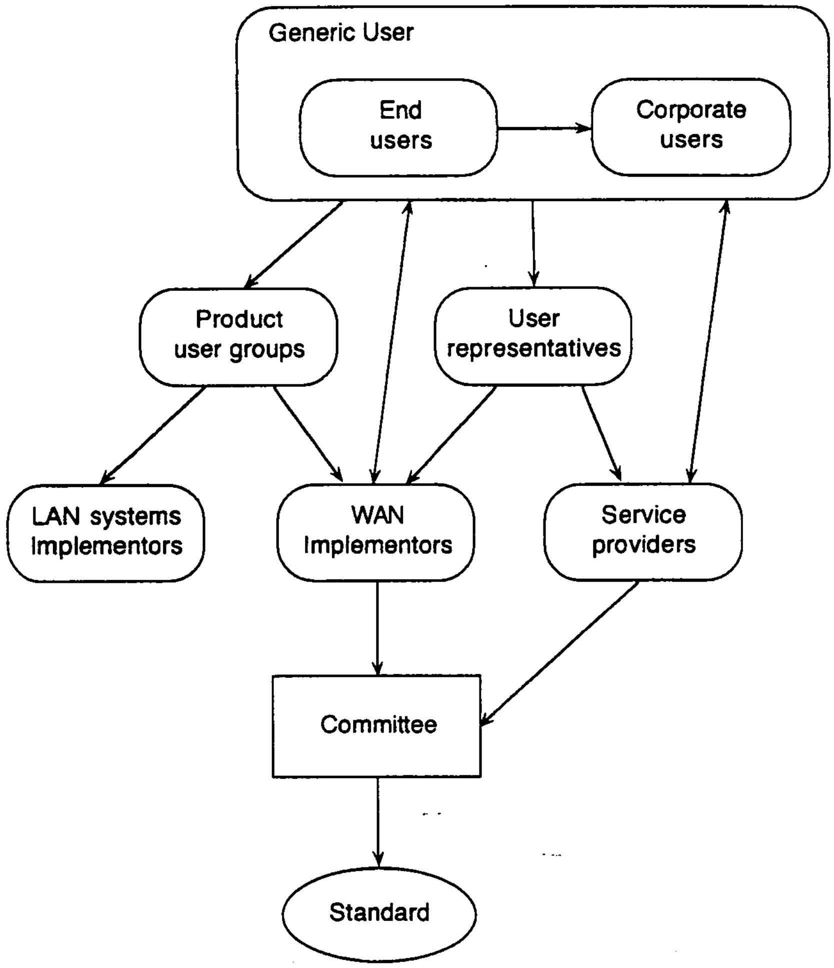

FIGURE TWO.
A more realistic picture.

works. Thus, at least from the end-users' point of view, these wide-area systems are hidden behind the respective local ones. This, once again (at first glance) reduces the need for standardized services, providing adequate functionality appears to rest with the vendor of the LAN-based systems. Accordingly, product user groups (for LAN-based mail systems) are another popular means to exchange information and convey requirements.

"We are members of the Microsoft Mail user group. We do seem to get benefits from user groups. We seem to get major benefits from meeting and talking to people that have been in the same situation." (Corporate user representative, 1995).

Moreover, established user organizations, such as (E)EMA, are perceived by many as representatives of users in standards-setting bodies. EEMA has recently decided to become active in this area. This is not a first, the International Telecommunications User Group (INTUG) has long represented users, especially in committees of the ITU (though apparently not too successfully).

The fact that about 80% of total email traffic will be within the respective local system anyway, further reduces the importance of the interconnecting system. One rather extreme position is that the 10% of traffic that has to go from one local system through a gateway into the backbone and through a second gateway into another, different local system is just not worth the effort, even if it causes severe problems for some users.

Finally, two other interesting points: First, the unanimous opinion of the interviewees was that they would not be able to do their day-to-day work without using email. Second, for almost all companies, compatibility to standards has been a prerequisite for their wide-area systems. While most decline to contribute to standards-setting, the value of a globally standardized service seems to be well understood.

CONCLUDING REMARKS

Our study of large corporate users' attitudes toward standards-setting for electronic-mail services revealed that they do not show much interest in spending time and money on participating directly. Three factors can be identified that may go some way to explaining this surprising result. Taken together, these factors discourage corporate users from active and direct participation in standards-setting.

First, formal standardization processes (i.e., those embraced by ISO and ITU) are seen as costly, cumbersome, time-consuming, and bring no guarantee of success. Standardization is not a simple technical activity but is influenced by political, economic, and social factors. With the search for international, and increasingly comprehensive standards, standards-setting must cater to an ever-increasing range of players. Thus, it is little wonder that the formal processes of ISO and ITU are frustratingly slow, and sometimes highly ineffective.

The characteristics of the standardization process itself, as perceived by experienced committee members, do not exactly encourage users to join in the game. In particular, user participation remains a controversial topic. Although both ISO and ITU have attempted to promote greater user participation in standards-setting, our study indicates that this has not been a success.

Second, long-term planning has started only fairly recently and, in particular, use of electronic messaging has not become strategic. Therefore, little additional functionality has been needed. Users understand the requirements very incompletely at this stage, and so their contribution to defining standards is very limited. We argue, however, that the ongoing diffusion of electronic-mail services into companies and organizations, and especially the likely integration of email into business-critical processes, will make strategic planning essential. User participation will then grow in importance as users seek to ensure that the lessons learned earlier are incorporated into usable products and services.

Third, these problems stem largely from inadequate implementations of the standards rather than flawed standards. For solutions, users naturally turn to system vendors and service providers rather than to standardization bodies. It is clear that, at least for the day-to-day problems, talking to vendors and service providers is the more practical approach, especially as these problems normally require quick solutions, rather than lengthy strategic planning.

The close(r) relationship between users and suppliers may better support the learning processes users must undergo to achieve a usable implementation of a new and organizationally systemic technology such as email [Fleck 1993] than may the committees of standards-setting bodies. In the long term, however, vendors and service suppliers cannot be relied upon to act as proxies or neutral conduits for users' requirements. Our study shows that vendors and suppliers already dominate the standards committees, with the result that standards-setting within communications services continues to be largely technology-driven and supplier- or vendor-led. Services tend to reflect suppliers' and/or vendors' priorities (e.g., manageability) rather than usability. The influence of communication service users is limited to the marketplace, where the choices may already be constrained. Though this is in keeping with the traditional picture, we believe that this falls far short of the kind of user participation that will be required to address usability issues in the future. It should not remain the only—or principal—means by which users gain influence on standards decision-making.

It will never be practical for each and every user company to participate directly in conventional standards-setting processes. We suggest that user groups and user organizations such as EEMA would be better vehicles for user representation and participation on standards-setting committees than individual companies. Indeed, we note that EEMA has recently decided to become active in this very area.

While there is general agreement among standards committee members that greater user participation would have beneficial effects, there is also considerable reluctance to press further. This is understandable—if user participation is pursued within current standards-setting and frameworks, an already cumbersome and often ineffective process would become even more so. For user participation in standards-setting to be successful, new mechanisms need to be developed that counter the evident practical obstacles and are also acceptable to the standards-setting community.

As some of our respondents themselves suggested, one solution is to encourage new ways of incorporating user input into standards-setting processes through use of the large number of different kinds of computer-supported cooperative work (CSCW) and groupware tools. Within the past five years, almost countless electronic fora (e.g., email distribution services and bulletin boards) devoted to user issues have sprung up on the Internet (including over 850 bulletin boards devoted to computing topics). Such tools may be a practical counter to the complex and highly distributed character of the social learning processes that accompany the implementation of organizationally systemic technologies. They enable users to pool their knowledge and experiences, and so accelerate their own rate of learning without incurring significant overheads of time and effort. The growth in such discussion-oriented services is now being matched by that of electronic publishing services such as ftp and the World Wide Web.

We suggest that standards organizations look urgently at how the exchange of views and dissemination of information afforded by these services could facilitate greater user participation in standards-setting. For example, bulletin board services could be used to gather user opinions, experiences, and feedback, and the Web could be used for the dissemination of draft standards.

It cannot help but seem ironic that communications standards committees are failing to exploit the communications technology to its full potential. At the very least, by using the technology to support their work committee members might gain better insight into the needs of the wider user community. **SV**

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COMPETITIVE ADVANTAGE THROUGH PARTICIPATION IN STANDARDS SETTING?

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The paper discusses the question whether or not large corporations should actively champion their needs and requirements in the international standards setting process. Taking the electronic mail service as an example, views of company representatives and senior members of relevant standards committees are reported. These statements have been compiled through interviews and questionnaires. To a considerable extent both parties agree that increased user participation cuts both ways. Based on these opinions, some proposals are made how to provide convenient means for input from the user side whilst avoiding the perceived drawbacks of direct committee participation.

INTRODUCTION AND MOTIVATION

For quite some time Information Technology (IT) has been at the very heart of every large organisation. More recently, electronic data communication services started playing an extremely crucial role, practically forming the lifeline of these organisations. This holds particularly for the electronic mail (e-mail) service, which provides a fast, efficient and function-rich alternative to both, letter and telephone.

Over the last ten or so years three crucial trends resulted in the need for global, non-ambiguous and adequate standards for communication services for the business community. These trends reflect the general development of increased globalisation of and collaboration between businesses:

- *integration*
  companies are merging or acquired, with a very high likelihood of resulting heterogeneous IT and communication environments,
- *internationalisation*
  moving into new markets will require adaption to the respective dominant local system (as eg. X.400 in Europe and the Internet in the US),
- *cooperation*
  the degree of cooperation even between possible competitors is increasing, again yielding the need for reliably working inter-company communication services.

One of the major developments in the IT sector reflecting these trends was the move from proprietary e-mail systems - almost exclusively employed until the early eighties - towards 'open' systems - ie. TCP/IP or OSI-based communication networks in general and e-mail services in particular. However, this represented only the first step towards globally homogeneous, useful and usable communication services. Today, major issues include interoperability between these two communication worlds, full implementation of the respective standards, and integration of high-level communication services into existing IT-infrastructures.

On the other hand, international standardisation bodies such as ISO and ITU have been struggling to keep in touch with the fast developments primarily triggered by the market. New procedures (eg ISO's Fast Track) have been adopted, and even new bodies have been funded (such as the European Telecommunications Standards Institute) in an attempt to deliver adequate standards specifications in a timely fashion.

This paper will discuss the need for standards in the field of e-mail, which has made its way into the offices of virtually all major international organisations. and will review the pros and cons of the participation of user company representatives in the standardisation process. The discussion will largely be based on interviews done with representatives from both, large, globally operating corporations and standardisation committees.

USERS IN IT-STANDARDISATION

Given the very diverse nature of the groups involved in the standards setting process it is easily conceivable that their opinions differ widely with regard to user participation. A reasonably uneducated initial guess would be that the 'official' point of view calls for stronger participation of user representatives. In an increasingly competitive standardisation environment the idea would be that user participation can help raise specifications' chances of survival in the market place. It is - or at least one would want to think it is - in every standards setting organisation's interest to produce specifications that meet the demands and requirements of their prospective users, and thus stand a chance to be actually employed as a basis for products or services.

On the other hand, work group members will hardly be pleased by the idea of an increasing number of participants. To make matters worse, these new members may be expected to be not as technically sophisticated as standardisation 'professionals' would deem necessary. Accordingly, you could anticipate major reservations against a larger number of user representative on the committees. Yet, assuming that single committee members also like to see the specifications they are producing being turned into products, one might also expect that user participation is considered useful if restricted to requirements collection and reviewing, as opposed to fiddling about with the purely technical aspects.

Looking at the issue from yet another angle, you could expect users themselves to be quite ambivalent in their views. Leading edge users, strategically employing state-of-the-art technology to support advanced applications and organisational structures are likely to have clear additional requirements on existing services. They may therefore decide to carry these requirements into the standards setting process. To have at least a realistic chance of success, however, their efforts should be backed by sufficient spending power. That is to say, if leading edge users at the same time happen to be sufficiently large (ie Boeing, General Motors, British Airways, Reuters and the like) they may well be in a position of being successful with pushing their requirements through.

In contrast to that, you would expect that less sophisticated organisations without far-reaching requirements will tend to consider involvement in standardisation being just not worth the effort. They will either try to get by on what they have got, to talk to their service providers and/or vendors in order to get 'customised' solutions (with all the risks and problems associated with this approach), or to solve the problems internally by integrating 'home-made' enhancements (with largely the same problems as customised solutions). Moreover, to actively get involved in the standards setting process will probably be regarded as being far too expensive and time consuming for smaller users ('Small and Medium Enterprises - SMEs, to use the popular EU-term), especially in times of recession. What's more, the eventual outcome of such involvement lies too far in the future, and is far too uncertain, as to be of any perceived real benefit.

The Users' Side

One general finding so far has been that corporations, even larger ones with a very favourable general attitude towards e-mail, show very little interest to influence standards setting. This holds despite an (although limited) number of identified functional shortcomings. Instead, we found that they look to service providers and vendors to come up with solutions to such problems. Apparently, companies do not see any business benefits in standards activities and are therefore not prepared to spend considerable amounts of money on people travelling to meetings and working on standards committees. Where representatives of corporate users do participate in standardisation, this appears to be largely based on "personal initiative plus a supportive director" [Jakobs et al., 1996].

There are a number of factors which might explain this result. One is the current corporate perception of e-mail. Of the large number of mail-enabled applications available, only a handful were represented amongst the corporate users in our study; interpersonal messaging was unanimously identified as the single most important e-mail application. Thus, within our sample, e-mail at present is little more than a very convenient new communications medium. In particular, in the vast majority of our case studies it is not as yet employed as part of any business-critical processes, and so far has no real strategic significance. Indeed, interviewees reported that sending business-related information via e-mail is discouraged in almost all the European companies in the study. This is largely - though not exclusively - due to the perceived lack of security of the medium (see also eg [Jakobs and Lenssen, 1994]). US companies apparently adopt a more relaxed attitude.

Another important factor underlying current attitudes towards participation in standardisation is the way in which corporate e-mail services have developed [Fichtner et al., 1996]:

- For quite some time other, more down-to-earth e-mail related issues had to have higher priorities (like eg. providing reasonably smooth interworking between different systems).
- Strategic planning in this area has started only fairly recently, in particular, e-mail has not yet been part of strategic applications. Therefore, little, if any, additional functionality has been needed so far.
- Problems identified stem largely from inadequate implementations of the standards rather than flawed standards. As one consequence, the direct links are to system vendors and service providers rather than to the standardisation bodies.

This is seconded by two notions: first, a requirements analysis, the outcome of which would be the basis for any meaningful participation in standards bodies has not normally been performed. Second, apparently US organisations are more active in standardisation bodies. Given that the US are a couple of years ahead of Europe in terms of corporate e-mail usage, especially as far as business-critical use is concerned, you may expect to observe a similar development in Europe in about three to five years time [Jakobs et al., 1997]. This is, however, just a spotlight, more data will be needed to substantiate this prediction.

One further factor may contribute to the reluctance to participate in standards setting: the vast majority of functional shortcomings, flaws and problems identified by interviewees stemmed from poor implementations of standards, rather than inadequate standards per se.

The shortcomings and problems cited most often include addressing, notifications (an indication that a message has been delivered to, or received by, the addressee), security, transmission of binary files, and more comfortable editing facilities. From these, the only one truly related to a deficiency in a standard is addressing in X.400. Apart from that, the others merely emphasise that current implementations of messaging standards are less than satisfactory. This holds for X.400, and to some lesser extent for the Internet as well.

X.400 provides for a number of different notifications, including 'delivery notifications' and 'receipt notification request indications'. Many security features have been specified as well, designed to cope with (amongst others) problems of masquerading, modification of information, repudiation and leakage of information. Again, the problem is that these are rarely implemented. Transmission of binary files represents a major problem to some Internet users for similar reasons.

In the light of the above it seems understandable that a corporate user would rather persuade a vendor to offer a full implementation of a standard in the first place, than go to great lengths and push additional functionality into a standard specification. This holds all the more since none of the interviewees reported pressure from end-users for functionality beyond what is currently being provided (typically apart from local implementation details), and none of the service providers has yet been confronted with user requirements beyond X.400's functionality.

The Standardisation's Side

Standardisation is not a simple technical activity but is influenced by political, economic and social factors (cf eg [Hawkins 1995]). With the search for standards that are truly global and increasingly comprehensive, standards setting must cater for an ever increasing range of players. Thus, it is little wonder that the formal processes of ISO and ITU tend to be frustratingly slow, and apparently, sometimes highly ineffective.

Figure 1 shows the picture of the relations between players in standards setting process (at Work Group level, where the actual technical decisions are being made) which emerged from our study [Jakobs 1996a].

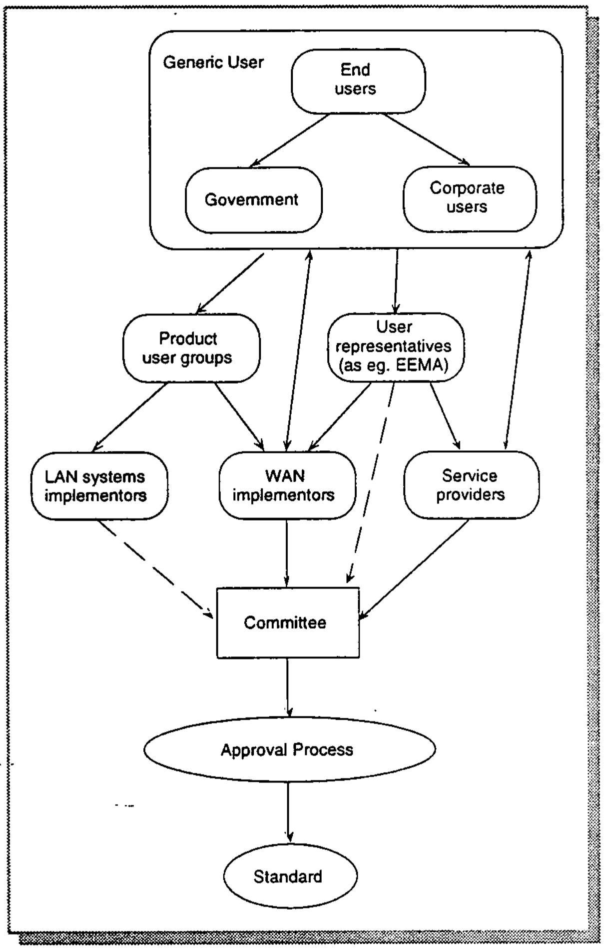

Figure 1: Relations Between Stakeholders in the Standardisation Process

It could be concluded that implementors and service providers - deliberately or not - act as a 'buffer' between users and standards committees (the double-arrows in the figure). Helping their customers (the users) to resolve short-term problems in an ad-hoc manner implies that established processes and procedures are being bypassed for the sake of a quick solution. As a result, you might suspect that at least some user requirements simply do not make it into the standardisation process because of this 'buffering' phenomenon. Moreover, there is a danger of creating incompatibilities if additional service elements are added only to meet single user demands.

Although standardisation bodies have attempted to promote greater user participation in standards setting (cf eg [ETSI 1992] or [ISO 1995]), our study indicates that this has not been a success. Standards setting within communications services, even for the higher, more user-oriented layers, continues to be largely technology driven and supplier or vendor led. As such, the services offered tend to reflect suppliers' and/or vendors' priorities (eg manageability) rather than user needs, eg usability. It would seem that the influence of communication service users is limited to the marketplace, where their choices may already be limited.

The Committee Members' Side

Amongst standards committee members opinions are somewhat split on whether or not increased user participation would be of benefit. Whilst there is no general disagreement that input on real user requirements could lead to a wider and/or faster acceptance of standards-based products in the marketplace, there is also considerable reluctance to increase the size of committees even further. Moreover, users are widely considered as being not sufficiently knowledgeable in technical terms, and thus be more a millstone around the neck than anything else. This position is understandable if user participation is pursued within current standards setting procedures and frameworks; an already cumbersome and often ineffective process would become even more so.

However, there have also been outspoken supporters of more user input to the committee work. In fact, and maybe somewhat surprisingly, these supporters form the majority:

> *"We don't think our standards would have come into being without user involvement. The vendors wouldn't have done it for us. What we need now is a method to make the users even better participants, without asking them to travel all over the world."* (committee member, 1995).

Still, a significant degree of reluctance to let user representatives have a greater say in the process is apparent as well:

> *"I am sorry to say the contrary of what is generally expected but I do not believe in the interest of users' opinion, at least in Telecommunications. Users need to transmit the maximum of data to the best price. After that, they do not care if it is IP, X.25 or Frame Relay. Or if they care, it is because it is writen in their newspaper that this technique is the best one!*
> *Telecommunication domain is very complex. And most of users have not the time (and it is not their job) to analyse technical things in that matter. I believe that users' needs are best defined by operators people, in the condition that there was a good link, internally to the operator's company, with the client (genreally through sales people)."* (committee member, 1996)

Finally, a third group was in support of increased user participation under certain conditions, or within only limited areas where these respondents felt users could contribute:

> *"Possibly for the generation of requirements, user participation might be useful. But, I think not for solutions, because, in general, the users do not 'engineer' the solutions."* (committee member, 1996)

These quotes pretty accurately reflect (in decreasing order) the three predominant schools of thinking popular among senior committee members.

Considering User Requirements

The integration of user requirements into the standards' specification process is of potentially crucial importance for users. If their requirements were adequately identified and dealt with, there would be no need to participate. The formal procedures which have been established by the 'official' standards setting bodies leave you with the impression that well-defined user requirements are essential and an important part of the process. Indeed, it seems that without adequate requirements from the user side no activities at all are initiated. However, the question remains whether these procedures are actually adhered to, and how the reality in the work groups and committees looks like with respect to 'integrating user requirements'. The answer to this question should to a considerable degree influence stance users' take up at participation in the standards setting process.

A straightforward approach would be to consult - better yet to invite - user groups or associations, representatives of which could actively participate in the standardisation process and could act on behalf their respective constituency. This should be done either before the actual standardisation activity commences, or during its very early stages. In theory representatives form users and user associations are free to participate in the process. In practice, users are dramatically underrepresented in the committees.

Both formal and informal cooperations have been acknowledged by the respondents. Formal cooperation is in place in a few work groups, whilst others reported no such links. Typically, formal cooperation is on a liaison basis, that is, the user group participates in meetings and receives the written output, but has no right to vote. There are also informal cooperation through personal contacts, or through organisational delegates wearing the additional hat of a user group representative.

> *"Relevant user groups are granted liaison status with committees; in some cases the liaison is 'formal', meaning that paper is*

transferred, in other cases a representative of the user group attends meetings regularly." (committee member, 1994).

Yet, it seems that all cooperations are at the discretion of the respective committee, and that it is very much by chance if cooperation in whatever form occurs.

Another approach, adopted and subsequently canceled by both, ISO JTC1/SC18 and ITU-T, was to employ a 'user requirements' WG (the term 'service definition group' was used by ITU).

> *"SC18 made a big show of developing user requirements; it even had a whole working group devoted to the process. I think the effort largely failed because (1) nobody could agree on what a user was, (2) the other WGs tended to look at WG1 (the user requirements group) as an impediment, and (3) when budgets got tight, nobody could afford to send real users to meetings just to oversee a process."* (committee member, 1994).

However, it looks very much as if this approach was a failure in the eyes of many committee members - if they happen to know about such groups in the first place. Whilst overall the comments range from *"invaluable to the standardisation process"* to *"at best as not necessary and at worse a hindrance."*, most of the interviewees, including ITU members, conceded that they had no idea what this group did, or that they did not have sufficient experience (if any) with their work to comment on it.

A popular perception held by a number of respondents can be summarised as follows:

> *"Unlikely to be valid representatives and often negatively regarded by those who believe they do the 'real work'."* (committee member, 1995).

This seems to be a major issue here. Even if a 'user requirements' group were established, they would have a major credibility problem with two different facets: First, the group would need to prove that it actually is a representative of the whole user community, and not just representing, for instance, some very large users or users of specific products only. Second, it would be an uphill struggle to convince members of the technical groups that they do valuable work and contribute significantly to the overall process. Especially the latter, rather more psychological problem is almost impossible to overcome in the short term (if at all).

FINAL REMARKS AND CONCLUSIONS

The 'official' standardisation processes (i.e. those embraced by ISO and ITU and, to some degree, by the IETF), are widely perceived as being costly and time consuming. Moreover, once a problem has been identified by a user it will definitely be too late to try and solve it through establishing a new, or modifying an existing standard (a process which typically takes years). Thus, it does not exactly come as a surprise that companies are very reluctant to invest in people (employees or consultants) to champion their needs in standards committees, without any guarantee of success.

Given the process as it currently stands, users cannot be blamed for their reluctance. Ad-hoc problems can far easier be solved through contacting the implementor or service provider, and to address long-term, strategic problems that way is an extremely costly and risky business.

There are two more issues to be considered. Firstly, from the responses of corporate representatives in can be concluded that during the early stages of the employment of a new (interpersonal) communication system users typically do not have any real functional requirements. Even today e-mail hasn't quite gained real strategic significance in most companies, and remains little more than a convenient interpersonal communication tool, complementing and maybe gradually replacing phone and fax machines.

Secondly, it appears that new ways of incorporating user input into standards setting processes are required. The process is lengthy and costly, with no short-term return on investment from participation in sight for users. Moreover, when it comes to technical problems users apparently would have a credibility problem in quite a few committees, as have dedicated user requirements groups. Standards organisations should look urgently at how to utilise new electronic media for discussion, information dissemination and, last not least, to facilitate greater user participation in standards setting, at least for requirements compilation. However, it should be noted that a considerable number of standards committee members second this proposal. In fact, (better) use of readily available electronic communication media could generally improve and speed up the process.

Another alternative to foster increased user participation while at the same time taking into account the concerns voiced by committee practitioners could be the channeling of user input through established international and independent dedicated user organisations. Such organisations would be in the position to represent all their members in the standardisation process. In fact, the World Electronic

Messaging Associations (WEMA), for example, are considering to become active in this area. However, it should be noted that this is not a first, the International Telecommunications User Group (INTUG) has long been representing users especially in committees of the ITU (although apparently not too successfully).

Whereas benefits of standards and standardised e-mail services have been acknowledged and appreciated by all users in our study, identified user requirements in terms of additional functionality are few. This situation, however, is likely to change: with the ongoing diffusion of electronic messaging services into companies and organisations, and especially with the predictable integration of e-mail into business-critical processes, additional needs are likely to emerge, which cannot be fulfilled by simply talking to vendors or service providers. We would therefore predict increasing user involvement in the standardisation process in the not-too-far future.

Finally, to summarise the answer to the question raised in the title: under current circumstances users should expect to gain little benefits from participation in standards setting. With upcoming new requirements, and with new procedures designed to simplify participation in the process, this will change in the medium term.

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INTRODUCING IT: LESSONS FROM CASE STUDIES OF E-MAIL

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Adoption and implementation of electronic messaging systems in large international organisations creates a number of non-technical problems. Based on results of case studies of organisational implementations of e-mail services these issues are identified and discussed, and the strategies employed to overcome them analysed. Subsequently, end-user issues related to messaging services are discussed. We examine the different degrees of user training and support offered, and the mechanisms in place allowing end-users to contribute to subsequent service developments and enhancements. We conclude with recommendations for tackling some of the problems observed.

INTRODUCTION

One of the central dilemmas in the organisational implementation of Information Technology (IT) today concerns the relationship between the central and the local. On the one hand, the vision of the strategic application of IT advanced, for example, by proponents of Business Process Re-design (Hammer and Champny, 1993), implies a centrally planned, top-down design and implementation of systems coupled to a radical transformation of organisational practice. On the other hand, research into IT implementations has revealed the importance of bottom-up strategies allied to local individual and collective learning processes in which technical potential is explored and fitted to the specific current and emerging requirements of groups of organisational end-users (Friedman, 1989; Fleck, 1994). The latter points to the contingency and heterogeneity of organisational information systems, viewed as complex configurations of diverse technologies and working practices. However, such a heterogeneous approach to IT systems remains problematic in relation to distributed IT systems, which exhibit strong network externalities, i.e. where the value for each user of being on the network increases with every new player joining the network. For example, if different local systems are incompatible, this will limit the benefits available from using the system.

For distributed IT systems such as electronic messaging services, two kinds of barriers to successful implementation may be particularly important. The one most commonly recognised is at the technical level of interoperability, where differences between various proprietary solutions or different generations of technology may mean that systems cannot interoperate or that some functions cannot be shared. However, another, potentially more significant barrier in terms of the cost and effort needed to overcome it arises from the commitment of end-users to their own locally-chosen systems -- which may represent a substantial investment made by large numbers of people to learning how to use a system and to apply its functionality to their working activities. This may result, for example, in a reluctance on the part of some end-users to comply with the imposition of organisation-wide, standardised services.

We explore these and other, related issues through of a number of case studies of the implementation -- i.e. adoption and development -- of e-mail services in large, international organisations in a variety of different business sectors including finance, chemistry, aviation, and oil.

BACKGROUND AND MOTIVATION

The work reported here is part of a wider project examining those factors contributing to useful and usable electronic messaging services. Previous work has focused on the processes by which messaging standards are defined. The growing requirement for interoperability has established the need for standardised communications services. More recently, messaging standards have targeted higher level services, and the results have direct consequences for usability. Thus, the achievement of the desired high levels of usability makes it increasingly important to understand how standardisation processes work and, in particular, if and where they fail to address users' requirements, and why (Cargill, 1989; Hawkins et al., 1995; Jakobs et al., 1996).

E-mail was selected for in-depth study because it is by far the most popular network application, being utilised by an ever increasing number of users with diverse backgrounds and expectations. E-mail has by now made its way into the offices of virtually all large international organisations. Recent studies (e.g. Bagshaw and Lockwood, 1994) suggest that once it has been introduced at an organisation-wide level -- and thus network externality benefits fully exploited -- e-mail yields considerable advantages over traditional communication media such as letter, telex, fax, and phone. This holds not only for internal communication, but all the more if external business partners are accessible this way too. Major benefits identified include savings of time and money and process simplification, as well as enhanced reachability and cooperation.

Despite these significant advantages, however, companies implementing e-mail services have found themselves facing a number of problems. There are many factors which may impact upon the adoption of e-mail services and their subsequent take up and usage. Those of a more technical nature, such as functionality, reachability etc. are well-documented (Race Industrial Consortium, 1995). This paper focuses upon organisational factors and, in particular, the strategies employed (if any) in the adoption and development of e-mail services. We report on how organisations have responded to the problems of interoperability and the dilemma of bottom-up versus top-down implementation strategies, and the degree of attention paid to end-user issues such as training, the provision of adequate support facilities, and establishment of effective channels for user feedback as development proceeded.

METHODOLOGY

The study focused on large, globally operating enterprises. It was assumed that such companies would be more likely to have gained considerable experience with e-mail systems, to have employed real introduction strategies, and to have implemented adequate mechanisms to cope with user comments. Membership in user organisations -- e.g. the European Electronic Messaging Association (EEMA) -- was another selection criterion, as it was felt that such membership was indicative of a higher than average degree of interest in the subject. Companies studied were from very different sectors, including but not limited to finance, information brokering, transport, and petro-chemicals. Finally, the study was geographically limited to UK-based companies and branches.

Fifteen senior members of IT departments who also represented their respective companies within EEMA were interviewed. Typically, interviews lasted between one and three hours, and focused on:

- general experiences of electronic messaging services,
- introduction strategies used (if any),
- approaches how to address user-related issues,
- technical shortcomings of the systems used, if any, and
- how such shortcomings were overcome.

In addition to these face-to-face interviews, some company representatives were interviewed through questionnaires. In both cases, a common set of twenty-two open-ended questions was employed.

E-MAIL IMPLEMENTATION STRATEGIES

In this section we will describe and categorise the different strategies for the adoption and development of company-wide e-mail services within our case study organisations, and discuss their respective pros and cons. In doing so, it is necessary to link these strategies to the respective history of messaging services, that is to the situation that had emerged within each organisation before a central, corporate, top-down strategy was imposed. As will become clear, in the vast majority of case study organisations such a strategy was implemented only at a rather late stage. Only rarely was there evidence of a top-down strategy being followed throughout adoption and development (Jakobs and Fichtner, 1995).

Top-Down Strategies

The advantage of pursuing a top-down strategy right from the beginning of e-mail service implementation is that compatibility issues are more easily resolved and a solution providing homogeneous services throughout the whole organisation will be much more cost-effective. Also, the backing of senior management removes many obstacles.

> *"The decision to use electronic messaging was backed by the board of directors. Accordingly, the introduction brought at least very few organisational problems."*

However, one of the major drawbacks of pursuing a top-down strategy from the outset is that it removes the opportunity for individual and organisational learning, which may have serious consequences for the success of the project (Attewell, 1992). This was the experience of one of our case study organisations, where the introduction of e-mail was initially confounded by users' resistance to change. This resistance was itself directly linked to the fact that at that time the project began, e-mail's benefits were not really understood.

> *"In 1984, it was extremely difficult to convince people that e-mail was part of their job. People considered distributing information via e-mail as something vexatious."*

The organisations which followed a top-down strategy from the outset were either the smaller ones, or relatively young organisations founded within the last twenty years.

> *"The company was lucky in that one of its founders was quite keen on IT, so funding has not really been a problem. In the early days, decisions related to information*

technology in general, and to e-mail in particular, were very much taken by this person."

Even in these cases, it was noted that following a top-down strategy only eased the introduction of the first system; subsequent moves, e.g. from mainframe-based towards LAN-based systems, still caused considerable problems.

Hybrid Strategies

Overall, the results of the study suggests that large, international enterprises do not normally make top-down, strategic decisions about messaging services from the very beginning. This result may partly reflect the structure of the case study organisations, the majority of which are subdivided into a number of almost autonomous companies or branches, located around the globe. The result was that end-users typically took the lead in e-mail adoption. Whether deliberate or otherwise, the benefit was the opportunity thus provided for the individual and organisational learning so often vital to the subsequent successful organisation-wide implementation of IT systems.

Typically, we found that IT-related decisions were made at departmental or site level. The result of this was that the IT environments in the case study organisations, particularly (but not only) messaging systems, were generally very heterogeneous. In general, this situation was aggravated by the existence of different generations of equipment, including mainframes, minis and workstations as well as an ever increasing number of PCs.

The consequence of a pattern of local, end-user led adoption on the one hand and the obstacles created by heterogeneous systems to interoperability on the other was the emergence of two distinct hybrid strategies which combined elements of bottom-up and top-down strategies, but in rather different ways. The first hybrid strategy we found holds for about two thirds of the organisations within the case study. In it, bottom-up adoption and top-down development strategies are pursued at different phases within the overall implementation process.

The Initial Phase. In classical bottom-up fashion, a group of employees obtained a messaging tool, either to fulfil a specific work requirement, or bundled in with other software.

> *"The first e-mail system was installed as part of a major IT project, when it was merely considered a tool enabling cooperation between project teams in 17 European countries. Its introduction was part of the project roll-out, and based on a management decision."*

> *"Use of e-mail emerged from the use of VAX-mail, which came for free with the operating system."*

The new service soon became popular. Slowly, mainly by word of mouth, information about benefits provided spread throughout the department.

> *"Word processors were bought, with e-mail being an integral part of this package, to be used by secretarial staff. Since then, electronic mail has made its way into other offices and departments."*

The number of users increased steadily, though still within the department or site, rather than at the organisational level. However, at the same time very similar developments took place at many sites, resulting in an extremely heterogeneous environment (see fig. 1) -- the inevitable outcome of the bottom-up approach. The conditions potentially now existed to justify the pursuit of a top-down strategy to e-mail service development.

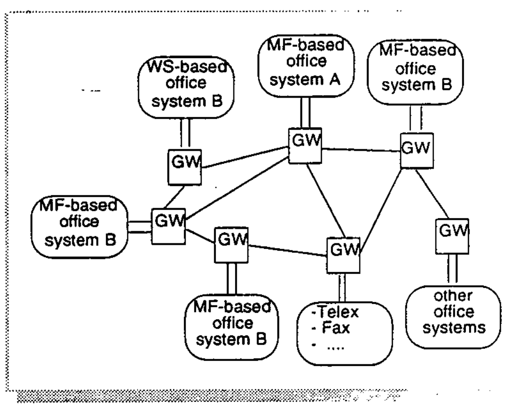

Figure 1: A Typical Environment at the End of the First Phase (MF = Mainframe, WS = Workstation, GW = Gateway)

The Second Phase. Users now recognised the need for integration as they experience the problems of the incompatibilities between the patchwork of systems adopted at different sites. In some cases, there were more than ten different mail systems. The degradation of organisation-wide communication quality was severe and often costly and frustrating for users.

The case for following a central, top-down development strategy as a solution to these problems was now very strong. Unfortunately, its acceptance depended upon senior management being convinced that the major expenditures related to purchasing, installing and maintaining a (more or less) homogeneous e-mail service were justified by the benefits. A critical mass of e-mail users had to be reached -- and individual and organisational learning had to take place -- before the implications of factors such as network externalities could be fully appreciated and the costs of a top-down strategy thereby justified.

Attempts to institute a top-down development strategy began: a central entity took over and tried to integrate the different services with management backing.

> *"Originally it was an effort led by techies, now it has much management support."*

Fig. 2 sketches a messaging environment which could typically be found some time after implementation of a top-down strategy.

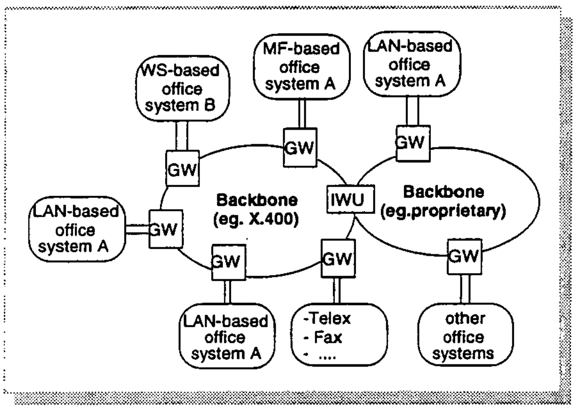

Figure 2: A Typical Environment During the Second Phase
IWU = Interworking Unit

Also during this phase most organisations started looking at more flexible and feature-rich systems, which were typically to be found on PCs or UNIX machines.

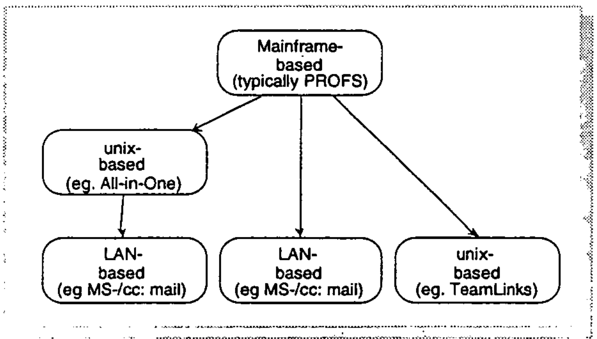

Figure 3: Typical Evolution of Electronic Mail Service Platforms

Another development supporting this migration was the then popular move away from (mainframe) IBM to smaller (UNIX-based) systems. In contrast to the initial service introduction, this move was always part of a top-down development strategy. This a general trend towards a higher degree of service distribution, this has been achieved via different evolution paths (see Figure 3).

The Third Phase. This phase, which many of the case study organisations are currently pursuing, is a continuation of the top-down development strategy, and is characterised by the introduction of a uniform local e-mail environment (e.g. MS-Mail or cc:Mail), interconnected through a messaging backbone (typically an X.400-based system or the Internet), which also offers access to the respective other e-mail world (i.e. the Internet or X.400). Completion of this step means that a homogeneous service will be available for most, if not all, users, and that the number of different gateways will be minimised (cf. fig. 4).

> *"Until we've got to the stage we've got an entire user population on one e-mail system we're going to have a degree of user annoyance."*

Whilst this may be an unrealistic goal for the time being, there is no doubt that this statement is true. As has been noted earlier, interconnection of different mail systems via gateways always leads to a loss of functionality, which in turn will frustrate affected users.

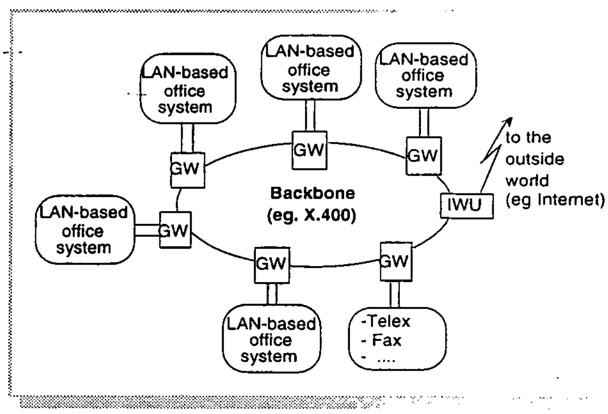

Figure 4: The Envisaged Final Outcome of the Process

Some of the case study organisations have gone to great lengths to push forward LAN-based systems, a move typically also resulting in problems, including:

- **Convincing management**
  The establishment of the first e-mail systems was achieved fairly painlessly and without major financial expenditure. However, convincing top management that a move from an apparently working service towards something new was typically quite difficult.

- **Service uptake**
  Despite their various advantages, LAN-based systems incurred a considerable extra overhead compared to centralised mainframes.

- **Convincing users**
  Once staff got accustomed to using to a certain service, organisations found it hard to persuade them to use something else instead. This was even more the case if the new service was still in its infancy, and likely to cause problems for some time.

- **System interconnection**
  There was almost universal agreement that a single e-mail service was the best solution for organisational messaging needs. However, this proved to be very difficult to achieve in practice. Consequently, most organisations have opted to establish an interconnecting (and integrating) e-mail backbone instead.

In contrast to the first hybrid strategy, where bottom-up and top-down strategies are pursued sequentially and contingently, the second hybrid strategy we found integrates the two in a systematic and pre-planned way: bottom-up adoption is steered and controlled through a parallel, overarching, top-down implementation strategy (Jakobs and Lenßen, 1994).

Use of the second hybrid strategy was observed within a large French chemical group. Sales staff and a special communications group were the first to be involved in the project. A simple adoption strategy was followed: people known be interested in trying and testing new techniques were persuaded to use the new e-mail service. Those people then had something like a catalyst function within their respective departments, serving to promote the further introduction of the system. Messaging could be demonstrated as being an attractive service. It was always made very clear that messaging was not intended to be a replacement of other established communication media, but an additional service, and that messaging would be as easy to use, and at least as effective as other communication services. Stressing these facts was considered crucial, as gaining users' confidence has always been a vital part of the internal marketing strategy.

Eventually, management and other senior personnel learned about the benefits of e-mail, largely by word of mouth. Once these people were enthusiastic about messaging, it became an important tool in their departments within very short time. It turned out that people suddenly found they had various obligations that forced them to use e-mail. In fact, this was simply because colleagues or superiors were using the system. This development was supported by group meetings, where messaging benefits had been presented, with senior staff sharing their related experiences. Such private success stories and experiences, as well as concrete business cases, contributed significantly to the system's further uptake.

This hybrid approach is of particular interest because it represents an attempt to combine the advantages of a pure top-down implementation strategy -- i.e. its speed-- with the advantages of a bottom-up adoption strategy-- i.e. the opportunities for organisational learning -- but without the latter's disadvantages -- i.e. the problems of incompatibility.

END-USER ISSUES

This section discusses the steps taken by the case study organisations to satisfy the needs of their users. and to promote the take up and usage of the e-mail service. Of numerous influential factors (see e.g. Yaverbaum, 1988), the topics addressed include user training. support facilities, and provision of channels to forward complaints, suggestions, problems etc. The latter may be taken as a measure, in part, of users' scope for contributing to subsequent service developments.

User Training And Support Facilities

Attitudes varied with respect to user training. The range of comments included

> *"Full user support on technical issues is provided on site, including user training"*

> *"User support enjoys comparably low priority".*

This is quite surprising, given the fact that the importance of user training has long been recognised, (see e.g. Nelson and Cheney, 1987).

The majority of the organisations considered (re)training of users as being of principal importance. In most cases, a substantial amount of time and money has gone into these issues, which include initial training courses for management and support staff; 'training the trainers' being a popular first step. Moreover, staff are employed by some of the organisations to serve in a training role, and to produce specific service documentation.

One company, which insists that staff follow an introductory training courses, considers e-mail as a major (positive) part of today's corporate culture. a view with which staff apparently concur. On the other hand, two companies said that user training is low on their respective priority lists. Although this number is certainly too small to draw any general conclusions, it is nevertheless interesting to note that one of these latter companies sees itself as being "still at an early stage of e-mail use" (after about eight years), with the other admitting that "despite their efforts e-mail is not widely used".

As discussed earlier, the commitment of end-users to their own locally-chosen systems may represent an important barrier when services are integrated and standardised. Some of the case study organisations have realised that forcing users to move from one e-mail system to another is not a good policy. Rather, they have tried to 'persuade' their users to move in the desired direction, by offering, for example, migration tools and better support facilities for the new service, yet whilst retaining (for some interim period) interconnection to the old one.

Despite the different attitudes towards training, the case study organisations are unanimous in their belief that help-desks are crucial to success. In fact, every of them offers access to a help-desk facility to its users, either internally or through a third party.

End-Users and Service Development

The organisations show similarly diverse approaches towards compilation of -- and reaction to -- user reports, suggestions and complaints. Whereas some do have rather sophisticated mechanisms in place for automatic logging of such user input, and have formally established bodies to analyse and react upon these reports, others simply leave it to the help-desk staff. The quality and volume of user input itself seems to reflect the respective approaches: users who know that their comments will be considered seriously appear to be much more willing to actually submit them (Jakobs, 1994).

One of the organisations in the case study has attempted to place users at the centre of policy-making about e-mail services, and is exploiting e-mail as a vehicle for requirements elicitation. A field request logging system is in place through which comments etc. can be sent to a central site where full-time staff are in charge of collating and analysing them. The results are then forwarded to the responsible service manager. A communication user group of about thirty people, drawn primarily from senior management, is responsible for long term service planning. It is within this group that compromises (where necessary) between local and organisation-wide requirements are determined. Recently, the company introduced MIME in response to user demand. Prior to a new product release, both a draft and a total requirements study are performed. So far, staff report that this approach has worked very well.
In contrast, a large proportion of the organisations stated that users have very little, if any, constructive requirements beyond the functionality they are offered. A correlation was apparent between the lack of user feedback and the absence of explicit support mechanisms for conveying and handling it.

Finally, an earlier report on user messaging behaviour within the same group of organisations observed that about four years after the introduction of e-mail, typically some 50% of their users were in a so-called 'bad traffic' zone, i.e. receiving or sending less than one message per day on average (Jakobs and Lenßen, 1994). Most of these 'bad' users commented to the effect that "it is not my fault that the traffic is that bad, there is nobody in the company who is willing to send me a message!". Three years later, half of these once 'bad' users had become 'normal' users, that is, they sent or received between 5 to 10 messages per day. This change was primarily due to better connectivity, and better integration of messaging services into the normal working environment.

Overall, we found that users within the case study organisations have generally responded positively to the introduction of e-mail services, but note that:

- e-mail services will lose their appeal if users do not receive 'enough' messages and
- it is important that progress continues to be made in terms of enhanced services.

CONCLUDING REMARKS

The dilemma between centralised, centralised, top-down and distributed, bottom-up strategies for system implementation is perhaps unavoidable in the attempts of very large, multi-divisional organisations to experiment with new and evolving technologies. Indeed, it lies at the heart of the continuing debate over the management of end-user computing (see e.g. Brancheau and Brown, 1993). Measures to limit experimentation with new technical alternatives to centralised functions would act as a barrier to innovation by reducing the scope for individual and organisational learning. This is one of the reasons why large bureaucracies in public administration and financial services were much slower than manufacturing organisations in adopting distributed computing (Adler and Williams, 1991). Management responses to end-user computing have been characterised variously as 'monopolist', 'laissez-faire' and 'managed free economy' (Gerrity and Rockart, 1986). The evidence of our case studies points to the apparent domination of laissez-faire strategies for e-mail service adoption which, as we have seen, leads to major problems once organisations are forced to grasp the nettle of interoperability and system incompatibilities.

Of the alternatives, a better strategy than the monopolist approach of suppressing locally-generated innovation, might be to develop policies that cater for it, and allow it to be fostered within more an overarching strategy. An example might be the second hybrid strategy revealed in our case studies. More specifically, given the importance of compatibility to services like e-mail, it might be useful to encourage local innovations on the condition that the need for migration strategies to eventual organisation standards is addressed. This might, for example, involve giving preference to systems built on open standards, including proprietary industry standards that have been opened out to complementary suppliers, and especially to 'architectural technologies' where some elements of a product remain constant, providing some guarantee of compatibility over several product generations (Morris and Ferguson, 1992).

Technical limits on interoperability constitute one potentially important barrier to such migration. Another barrier, which is arguably more substantial, is the commitment of end-users to their chosen systems and their investment in learning how to use them and adapt them to their working routines. The cumulative investment made by large numbers of organisation members is likely to be large relative to the costs of system acquisition -- as are the costs of transferring from the locally chosen system to the one adopted as the organisation standard. As our case studies show, users can be very reluctant to move from one system to another. Various persuasion tactics were in evidence in our case studies, but results were mixed.

User acceptance will be improved if the transfer to the new system is made relatively painless through the provision of useful migration tools (e.g. allowing users to retain their address directories they have developed; not needing to change existing e-mail addresses, etc.). A natural extension of this approach would be to provide the facility for users to retain the broad look and feel of the user interface (e.g. command language). Though such a proposal may seem difficult to achieve, the network externality benefits of standard user interfaces may themselves result in the widespread adoption of certain industrial standards in this area (Williams, 1993). Ultimately such external standards, for example for Electronic Data Interchange, may provide a template for internal integration and standardisation.

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Users in IT-Standardisation: A Myth Revised

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SYNOPSIS

Calls for increased user participation in standards setting are very popular among voluntary standardisation bodies, and are issued almost regularly. The arguments brought forward in this paper to challenge such calls are twofold: For one, if the schedule of a typical standardisation project is linked to the introduction of a new communication service typically to be observed in large organisations, a certain clash of schedules will be observed. Secondly, the paper argues that an unconditional 'call for users', even if it were answered, would probably be counter-productive, in that a simple increase of the number of users on the committees would not necessarily increase the number of user delegates, but of company representatives. The information and views presented have been compiled through a number of interviews with representatives of both, large companies and different standards setting organisations. The case of electronic mail (e-mail) is used to illustrate the arguments.

Keywords: Management, computer science, standardisation, information technology, E-mail.

1 INTRODUCTION

Common wisdom, frequently published by standards theorists and, notably, by the standardisation bodies themselves has it that there is a more than urgent need for an increase in user participation in standardisation. In many cases this is an unconditional statement, usually motivated by the perceived high risk of a standard's failure in the open market if no users were involved in its development. Taking electronic mail systems as an example I will have a critical second look at this popular (mis?)conception.

E-mail has been selected because of its relative novelty, while at the same time considerable experience has been gained concerning its use, especially in internationally operating organisations.

I will link the corporate 'introduction strategy' typically to be observed in the case of e-mail (and other communication systems) to users' reservations about - and, indeed, inability to - contribute to standardisation. Moreover, I will argue that participation at all costs doesn't buy anything; in fact, it may rather be counter-productive. Instead, user participation seems to be useful only after a reasonable time of actually using a service; meaningful requirements do not come out of the blue, but are rooted in sound experience. At the same time, however, the widespread notion that a standard's acceptability and chances of survival in the market place critically depend on users' participation during its development process remain very valid.

These observations have been substantiated based on a number of interviews conducted with both, standards setting professionals and representatives of large user companies. I will conclude that standardisation processes, at least in IT, will have to undergo major changes if they do not want to take the risk of becoming obsolete.

The remainder of the paper is organised as follows: Chapter two will briefly outline the course of a typical voluntary standards setting process, and the overall standards life cycle. The third chapter will report and discuss the views of long-standing standards committee members regarding the process they are involved in, and the pros and cons of user participation in this process. Subsequently, the typical e-mail introduction and implementation strategy to be found in large, internationally operating organisations will be outlined in chapter four. Following from that I will argue in the fifth chapter that the time schedule typically to be observed for e-mail introduction and implementation processes to a considerable degree interferes with meaningful user participation in standards setting. Finally, some concluding remarks will be made in chapter six.

2 THE STANDARDS LIFE CYCLE

Development of a standard is typically associated with a technical committee producing a proposal, which has then to be approved by the various instances of the respective organisation. However, this is only one part of the overall process of standardisation. Subsequent tasks like profiling and testing have to be considered as well, as has the final deployment. A rough sketch of the resulting overall standards life cycle, which covers all related efforts, is depicted in Figure 1 [1]. Similar cycle stages have been identified by other organisations as well [2].

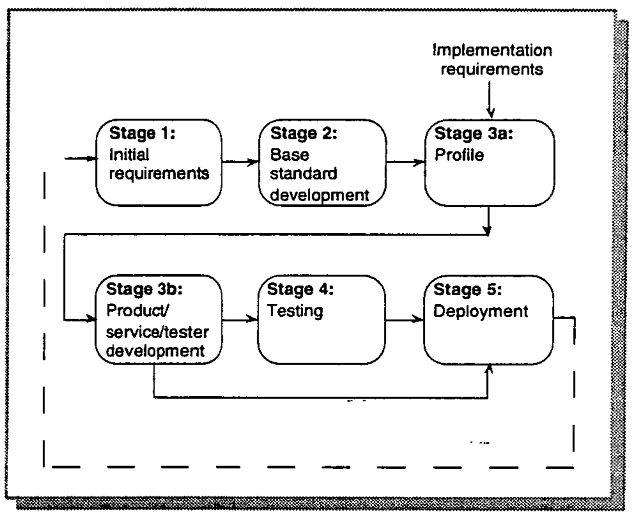

Figure 1: The stages of the standards life cycle

It should be noted that the dashed line to some degree represents wishful thinking, as no formal mechanisms are in place to provide a means to feed requirements resulting from service deployment experiences back into the standardisation process.

As can be seen in Figure 1, actually developing and writing the base standard accounts for only part of the overall development cycle. Today, three years are the minimum period for standards production within ISO, which is roughly equivalent to stage two plus a bit of stage one in the above model ([3], see also Table 1).

Project stage	Associated document	Time Targets
0 Preliminary stage	Preliminary work item	
1 Proposal stage	New work item proposal	
2 Preparatory stage	Working draft(s)	6 months
3 Committee stage	Committee draft(s)	2 years
4 Enquiry stage	Draft International Standard	
5 Approval stage	Final Draft International Standard	3 years
6 Publication stage	International Standard	

Table 1: The ideal standards development schedule within ISO

It must be noted that a period of three years represents the ideal situation which is not necessarily always reached. Using the 'Fast Track' or 'PAS' (Publicly Available Specification) procedures, this period can be reduced to one year in the formal process [4], [5]. This does, however, not take into account development efforts that went into the specification prior to submission, which means that the overall development times won't differ too much between the procedures. Roughly at least another four years must be added to any of these time spans to cover the other stages as well.

3 USERS AND STANDARDISATION

3.1 What exactly is a user?

Typically, the term 'user' is employed in very different contexts, and with very different meanings. A user of an e-mail *service*, for instance, may be a company or a government agency, or an human end-user; a user may also be a system administrator or even an application (e.g. Electronic Data Interchange, EDI). These services, on the other hand, are provided by implementors and service providers, respectively. Thus, they are also users; in fact, they are the true direct users of *standards*, which are incorporated in their products. The former, in contrast, may be referred to as indirect users of standards, as they are users of the standards-based products provided by the latter. Throughout this paper I will limit myself to the indirect users; the term 'user' will denote a company or organisation employing standards based systems and services.

3.2 User participation - committee members' views

The views and opinions reported in this section have been compiled through seventy interviews with senior members form different standardisation bodies (ISO, ITU, IETF, ANSI). Their views regarding increased user participation were split. A majority of the interviewees would welcome stronger user participation in and, even more so, stronger user orientation of the standardisation work. However, this vote was far from being unanimous. A broad range of reservations have been articulated, as well as a number or pre-requisites that would have to be met if more users were to be made welcome.

Despite all reservations, a benefit almost unanimously associated with increased user participation in the standards process is 'closer to reality'. That is, with users being more active in (parts of) the process, the final specifications are supposed to be closer to their needs and to enjoy broader acceptance in the market place. Thus, there would be a better chance of the specification being usable and what the customer actually wants.

Moreover, standards were supposed to be implemented more readily if it could be proved that they meet actual needs and to be bought if and when available. User input is primarily considered important for acceptance of a standard in the open market rather than technical brilliance. Consequently, most respondents sought user participation not for the work on the technical nuts and bolts of the standard, but to increase its final credibility and acceptance. This implies that users are supposed to provide requirements as guidelines for standards development rather than technical knowledge on how their needs can be met. This, in turn, means that users would only need to get involved in the process during the requirements compilation stage, and, more important, following practical experiences during the employment stage (stages one and five in Figure 1, respectively).

Only a very small group of WG members came from user companies, and a similar number actually saw themselves as user representatives. The most interesting bit about these groups is that they are not identical. Thus, even if the popular call for more user participation were answered it appears questionable whether this could actually improve the situation, as many committee members from user companies see themselves as representing their employers rather than the user community at large. It is worthwhile to keep this in mind, as it follows that calls for an unconditional increase in user participation will not necessarily help strengthen the user position in a committee.

4 THE TYPICAL E-MAIL INTRODUCTION AND IMPLEMENTATION STRATEGY

Overall, the results of the study suggests that large, international enterprises do not normally make top-down, strategic decisions about messaging services from the very beginning. This result may partly reflect the structure of the case study organisations, the majority of which are subdivided into a number of almost autonomous companies or branches, located around the globe. Typically, early IT-related decisions were made at departmental or site level. The result of this was that the IT environments in the case study organisations, particularly (but not only) messaging systems, were generally very heterogeneous.

The consequence was the wide-spread emergence of a hybrid introduction and implementation strategy which combined elements of bottom-up and top-down strategies. This strategy, which is outlined below, could be found at about two thirds of the organisations within the case study. In it, bottom-up adoption and top-down development strategies are pursued at different phases within the overall implementation process.

4.1 The initial phase - implementation

In classical bottom-up fashion, a group of employees obtained a messaging tool, either to fulfil a specific work requirement, or bundled in with other software. The new service soon became popular. Slowly, mainly by word of mouth, information about benefits provided spread throughout the department. The number of users increased steadily, though still within the department or site, rather than at the organisational level. However, at the same time very similar developments took place at many sites, resulting in an extremely heterogeneous environment (see Figure 2) -- the inevitable outcome of the bottom-up approach.

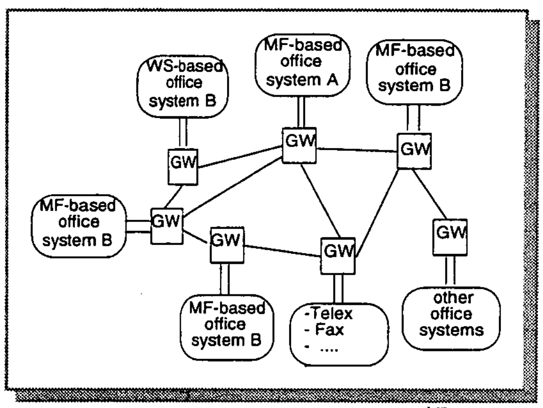

Figure 2: A typical environment at the end of the first phase
(MF = Mainframe, WS = Workstation, GW = Gateway)

4.2 The second phase - interconnection

Eventually, the number of problems reached a critical mass. Users now recognised the need for integration as they experienced the problems of the incompatibilities between the patchwork of systems adopted at different sites. In some cases, there were more than ten different mail systems. The degradation of organisation-wide communication quality was severe and often costly and frustrating for users.

Attempts to institute a top-down development strategy began: a central entity took over and tried to integrate the different services with management backing. Also during this phase most organisations started looking at more flexible and feature-rich systems, which were typically to be found on PCs or UNIX machines. This happened typically in the mid to late eighties.

4.3 The third phase - integration

This phase, which many of the case study organisations are currently pursuing, is a continuation of the top-down development strategy, and is characterised by the introduction of a uniform local e-mail environment, interconnected through a messaging backbone (typically an X.400-based system) which also offers access to the outside mail world (primarily the Internet). Completion of this step means that a homogeneous service will be available for most, users, and that the number of different gateways will be minimised. The final environment will then form the platform for more sophisticated, strategic mail-enabled applications.

5 THE CLASH OF SCHEDULES

The timeframe of the development outlined above is the important aspect with respect to user involvement in requirements compilation and verification for standardisation projects. Throughout the first phase, departments struggled to have the service up and running, and to actually use it. Neither sufficient knowledge nor resources were available to contribute anything to standards setting. During the following stage, technical problems, especially regarding interconnection of the single systems, had to have priority. Again, there could be little inclination to 'waste' valuable resources for standardisation work, the outcome of which could realistically not be expected to be of any help to solve the problems at hand. During or following integration, once the ad-hoc technical problems have been solved, and e-mail has been recognised - and is employed - as a strategic tool and has been integrated into business critical processes, new, additional requirements may be expected to emerge. Unfortunately, according to the case studies, this stage is typically reached after about eight at the earliest - if at all.

An earlier study [6] showed that for the time being even large, globally operating users, with a long-standing record of e-mail usage, have extremely few functional requirements that go beyond what e-mail standards, particularly X.400, can offer today. In fact, most requirements identified can be put down to the fact that today's implementations of X.400 offer only part of the functionality specified in the standards documents. For example, very few vendors can offer the security-related functionality of X.400.

As has been stated above, most companies are currently at an early stage of the 'integration' phase (after typically eight to ten years of experience, give or take a couple of years). Thus far they have used e-mail for little else than interpersonal communication. In particular, it has not yet become part of major business-critical applications. This explains the absence of any further requirements - the functionality of X.400-based systems is more than sufficient for even the most convenient exchange of interpersonal messages. It has to be expected, however, that new requirements will surface due the increasingly strategic use of e-mail in mail-enabled applications (as e.g. EDI).

Serious, centrally led exploitation of e-mail started at about the time when the first X.400 implementations appeared on the market. Users at that time simply were not in a position to contribute much to a requirements compilation simply because of the lack of experience with open e-mail systems (previous experiences with proprietary systems in a closed environment do not count for too much). Even if there were a formal mechanism enabling users to provide feedback to the standards setting process, it would only be now that they could start contributing new requirements (if at all). In between there was little chance of contributing much, simply because of their lack of experience with sophisticated applications requirements of which go beyond the limits of X.400. This is particularly devastating as meaningful user participation is largely confined to requirements compilation and, possibly, verification.

6 CONCLUDING REMARKS

Meaningful user participation in standards setting in the field of information technology suffers from two obstacles: Firstly, representatives of user companies do not see themselves as representing the user community, but their respective employer. From this it may be concluded that actual 'user representation' cannot be achieved through the mere presence, and work, of representatives from such user companies. Rather, it must be ensured that either these representatives see themselves as user advocates, regardless of their employer, or that the requirements of the different user companies are sufficiently similar. As it is most unlikely that the latter will hold - and next to impossible to verify even if it did - this possibility may safely be dismissed as unrealistic. Unfortunately, the former appears to be quite unlikely as well as it would require a very altruistic attitude on the side of the sending user company. Taken together these conclusions suggest that the only realistic way to achieve meaningful user representation is through a coordination of the single efforts, for instance through a dedicated user association representing its members' interests (as eg the World Messaging Associations, WEMA). Otherwise, there would be a real danger that increasing the number of 'user representatives' would primarily mean turf wars not only between different vendors and service providers, but also between users.

Secondly, it follows from the typical course of the introduction and subsequent usage of corporate e-mail systems that even long-standing users lack the experience to provide meaningful input to standardisation simply because they have not reached the required state of sophistication prior to the start of standardisation activities. In fact, at least in the case of e-mail most of them have not reached this stage more than ten years after the first version of an open e-mail standard was published. From these considerations it may be concluded that

- meaningful user participation is hard to achieve because of the long-lasting period of system usage at a comparably low level,
- participation at all is not particularly worthwhile unless real requirements can be contributed to the process.

Standardisation bodies should take this into account when planning a new campaign to recruit users for their committees. Despite all reservations I still feel that user participation is needed, especially for guiding a standardisation project, not least to counterbalance attempts to push company interest, and to safeguard committees from being dominated by techies. Thus, new mechanisms need to be established that allow users to do their job at reasonable expenses.

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