An Investment Framework for Information Technology Projects in Medium sized Organisations

Anthony D. Murphy

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Layout of Thesis and Research Programme

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Abstract

As computers absorb an ever-increasing proportion of corporate resources, and spread into every sphere of business activity, the issue of achieving benefits from investments in information technology (IT) is assuming major importance. Research evidence to hand suggests that IT investments are failing by orders of magnitude to provide appropriate levels of payback. A major part of the difficulty lies in the fact that management appears to lack a framework or even a language for addressing the issues, and are bewildered by the speed and impact of the changes that are taking place. This is particularly apparent in smaller and medium-sized organisations.

This thesis examines the causes of the problem, and suggests that it stems mainly from an undue emphasis being placed by management on finance-based techniques, a legacy from an earlier and much different environment. It seeks to establish that such techniques are not only inadequate, but potentially counter-productive. Using established research methodologies, a framework is developed which seeks to address the key issues involved in achieving business benefits from IT, yet which is understandable to, and applicable by, managers in medium-sized organisations. Uniquely among IT investment frameworks, the concept of business reengineering or business process redesign is introduced as a formal evaluation criterion, reflecting the degree of business transformation currently being experienced, and the central role of IT in that transformation. The framework is then validated and refined through being applied in actual investment decision making processes undertaken by five organisations covering a range of business arenas.

Part I Background to the Research

Chapter 1. Introduction

1.1 The Business and Social Impact of Information Technology

1.1.1 The coming of a new age

There are rare occasions, perhaps as rare as two or three times in a millennium, when society undergoes a change which is so profound and rapid that in the space of a few decades it exceeds that which occurred over the preceding centuries. This is described by Drucker. "Within a few short decades, society rearranges itself - its worldview, its basic values, its social and political structures, its arts, its key institutions. Fifty years later there is a new world. And the people born then cannot even imagine the world in which their grandparents lived and into which their own parents were born" (1).

The invention of the printing press by Gutenberg in 1455 illustrates this. By enabling books to be printed it resulted in an explosive growth in the dissemination of knowledge, rapid and wide advances in education, literacy and scientific discovery. Fifty years later America had been "discovered", and Martin Luther had launched the Reformation. Geopolitics and society had changed beyond recognition. The invention of the steam engine in 1776 set in train (no pun intended) the Industrial Revolution, and decimated the workforces in traditional industries such as boat building and agriculture, to name but a few. Wriston has shown how such fundamental transformations of society have a number of characteristics in common, even when separated by several centuries (2):

(a) Economic entities and professional activities, fundamental to the old order, in the new order either disappear completely, or incur a vast diminution in importance, for instance the impact of the steam engine on horse-based transport and on the canals.

(b) New economic entities and professional activities emerge and become paramount. For instance, engineers and the factory were unknown before the advent of the steam engine.

(c) The scale of political and social change matches that of economic change. The social, political and economic picture of Europe in 1825 was utterly different to that of 1775, as was that of the early sixteenth century to what had applied fifty years earlier.

(d) During the course of the transition, awareness of the significance of the changes is limited, understanding even more so. Many of the key expositions have only appeared at the end of the phase.

1.1.2 The birth of the Information Age

There is every reason to believe that the latter years of the twentieth century have witnessed the onset of another epoch-forming phase. The political evidence is underlined by the breathtaking collapse of Communism, the speed of which was unimaginable a little more than a decade ago. With equal suddenness, seemingly impregnable corporations such as IBM, Pan American Airways and General Motors either collapsed, or began to incur unimaginably large losses. Yet it was as recent as 1975 that a respected commentator like Rex Malik could make a seemingly plausible argument that IBM was set to take over the world (3).

The indicators of this change have been catalogued by Rolph & Bartram, Moss Kanter, and others (4). Company structures are transforming from the hierarchical to the flat, shedding vast numbers of employees in the process. As unemployment grows, and those in employment adopt new values and attitudes to work, trade union power ebbs away. Traditional manufacturing industry goes into decline, while services and knowledge-based industries grow. The collapse of trade and tariff barriers brings in its wake opportunities but also casualties. The tried and tested methods of the past no longer appear to work. In attempting to adapt, companies take measures unimaginable only a few years previously, engaging in mergers and take-overs, or even collaboration with former rivals. Many leading academics and business commentators suggest that only those who recognise what Drucker calls the 'decisive factor of production' will be able to adapt (5). This 'decisive factor of production' is information. We are at the beginning of the Information Age.

Tapscott and Caston, for instance, identify information and information technology as central to these developments. "Faxes provide students demonstrating in Tienanmen Square with information about what is happening in their own country.. thousands of networked personal computers become key battleground weapons (in the Gulf War). Global communications networks energise the metabolism of world commerce and move us inexorably toward Marshall McLuhan's global village" (6).

Cash, McFarlan and McKenney, in assessing the impact of IT on organisations over the previous 30 years, state that "new departments have been created, massive recruitment of new types of staff has occurred, major investments have been made in computer hardware and software, and systems have been installed that have profoundly affected how firms operate and compete" (7). They add that "IT's impact has not been confined to large corporations; in its current form it influences mid-size and very small .. firms as well". Rolph and Bartram state that "in the troubled nineties, many global corporations face one central issue on their information agendas - how to find and use the appropriate information to drive strategic change. This is especially urgent in view of the fact that many of the old business rules no longer apply" (8).

1.2.1 The IT payback paradox

This realisation has contributed to the explosive growth in the expenditure on information technology (IT), (IT being defined as computers, telecommunications, and the related software). For instance, this expenditure has grown by a compounded rate variously estimated as between 200% and 350% during the 1980s, (a rate far in excess of normal business growth) and now amounts to 50% of all new capital expenditure in companies in the US (9). In 1995 expenditure on IT by business and public sector organisations was estimated at £33.6 billion (10). Even developing countries are spending huge sums on IT, with Brazil, for example, expected to spend $10.2 billion in the 1993-2000 period (11). By 1992 in the US the computer equipment and services sector was larger than automotive steel, mining, petrochemicals and natural gas combined - a truly staggering realignment in the profile of industry (12).

While allowing that definitions of productivity might differ, figures claim that over the same period, white collar productivity (the focus of the bulk of IT expenditure) has risen by about 15% in manufacturing industry, and 3% in the services (13). Some studies suggest that at least 20% of expenditure is wasted, and that 30-40% of IT projects realise no net benefits, however measured (14).

It is suggested therefore that a huge and growing investment in IT seems to be failing to provide anything approaching a satisfactory return. The widespread disenchantment with the returns from IT among business manager should not therefore be surprising. For instance, *Computerworld* reports that "fewer than half (48%) .. said they were getting their money's worth from their organisation's IS spending"(15).

The remarkable nature of these statistics is underlined by the fact that the period referred to has been characterised by orders-of-magnitude increases in the price/performance ratio of computers (see Figs. 3.2.and 3.3).

1.2.2 The need for a new approach

The position could therefore be summarised as one in which a colossal ongoing investment in IT facilities has given rise to relatively small gains in productivity, at a time when the price/performance ratio of computing has shown dramatic improvement. Furthermore, with the conventional solutions no longer supplying the answer in overall business terms, an examination of the effectiveness of existing IT investment approaches seems called for. This is consistent with our being in the state of transition to a new epoch. Flinging computing power at the current business problems under the old parameters may be analogous to the attempt to breed bigger and faster horses to overcome the challenge posed by the steam and internal combustion engines. A new approach reflecting these developments seems to be called for.

1.2.3 Will a new approach be applied?

One would expect that, given the scale of the expenditure on IT, and the vast disparity between the growth in productivity and the growth in this expenditure, IT investment appraisal techniques would have been an issue of prime concern for business managers, and that imaginative new ways of evaluating IT projects would be in widespread use. One would also expect that the adoption of new forms of appraisal would have been given added impetus by the fundamental nature of business change taking place in recent years.

However, the contrary seems to be the case. For instance a study by Peat Marwick in 1989 showed that 75% of companies lack any effective evaluation procedures for new IT initiatives, (16) and a wealth of material underlining the predominance of traditional finance-based criteria is available (17). Yet, as Farbey *et al* show, the widespread perception that such (traditional) techniques are inadequate, has lead to a lack of confidence in appraisal techniques in general (18).

1.3 Summary

There is evidence therefore to suggest that the situation could be summarised as one in which a radical transformation of the economic and social climate is taking place, a transformation which raises doubts about the relevance and effectiveness of traditional approaches to business organisation. Information, enabled by information technology (IT), has played, and is playing, a crucial role in this transformation. Yet the evidence suggests that investment in IT has failed by orders of magnitude to deliver an appropriate level of payback. Despite this, traditional methods of appraisal continue to dominate the investment process.

Chapter 2. Research Objectives

The objectives of the research are to develop a framework for IT investment appraisal appropriate for present conditions, and to test the acceptability and suitability of the framework in a range of organisational settings.

The need for acceptability and suitability in research projects is emphasised by Remenyi and Williams when they state "some research studies stop at the stage of theoretical conjecture, perhaps having developed some hypothesis or empirical generalisations. It is argued that at this stage a contribution has already been made to knowledge and this may well be so. However, if the newly discovered knowledge is to be more widely useful, then it is usually necessary to progress to a further stage in the research in which the new thesis is tested against a larger sample population" (19). With this in mind, the research was conducted on an iterative basis on a broad sample in order to achieve the objectives of acceptability and suitability (see below).

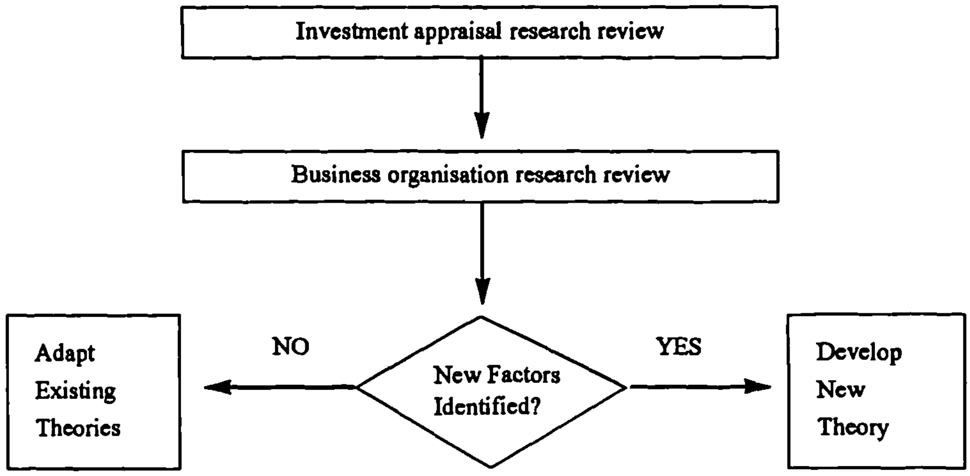
2.1 Research Strategies

2.1.1 Overview of Research Methodology

In view of the relatively broad scope of the subject, together with its potential to overlap with general business issues, a wide-ranging literature review was seen as the starting point. This identified relevant work to date and associated research methodologies. This review established that a number of investment criteria predominated, and formed part of the majority of the frameworks reviewed. These were then evaluated against the objectives of the research, i.e. to what extent did they provide the basis for a comprehensive framework, one which would appeared appropriate for a business setting.

The review also took in the literature on organisational theory, business management, and the organisational impact of IT. The purpose of this was to map the business success factors presented against those factors identified in the review of the investment appraisal literature. The steps in deciding on a new theory are represented diagramatically in Fig 2.1. This process revealed a significant omission (Process Redesign) from the methodologies reviewed, suggesting the need to develop a new theory. This is analysed in detail in Chapter 9.

Fig 2.1 Definition of Requirement for New Theory

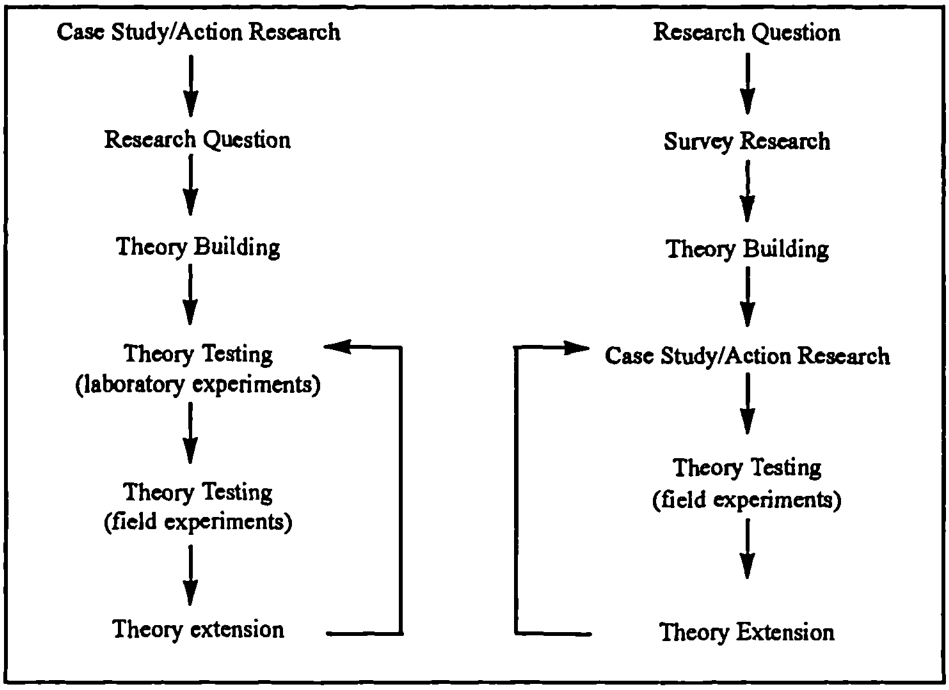


Once the requirement to develop a new theory was established, an initial theoretical framework was developed. Case and action research in a small number of organisations followed, and the findings were supplemented with the author's own work papers from earlier assignments, and by structured interviews with practitioners in the field, primarily in the business sphere, but also with academic sources. This lead to refinements and extensions of the theoretical framework, which was then further re-tested using the same process. This feedback loop was supplemented in three other ways:

(a) a survey of investment practices among 42 medium to large-sized organisations with a view to relating the fieldwork exercises to a broader context
(b) National Institute for Management Technology (NIMT) workshops with corporate clients on investment appraisal and IT strategy
(c) Seminars and conferences where the author presented papers on the theme of the research

This process closely relates to a research framework (right hand alternative) developed by Galliers, Jarvenpaa and Land which is shown in diagrammatic form on Fig. 2.2.

Fig. 2.2. **Development of Theory**



2.1.2 Fieldwork methodology

The first step in the field research was to identify a sample of organisations which would provide a representative cross-section of IT users. Having selected the organisations, a number of key staff were identified and asked to take part in the research. Prior to interviews taking place, the research objectives were described. Due to the innovative concepts (at least from the participants' perspective) being applied, some additional background material was generally provided (an example of this is provided on Appendix II).

The interviews and discussions took place at site locations, and were recorded by way of note-taking and workpapers. Following the interviews, supplemental notes and observations were contemporaneously recorded by way of tape recorder, and a summary of each interview was subsequently prepared. It was found impractical to use the same interview protocol for all managers, but there were no major differences. No standard protocol could be applied to the case/action research and theory testing, as these took place in radically different environments. As a final check on the research, participants were shown a write-up of the findings, and where applicable, changes were introduced.

2.1.3 Research techniques applied

Case Research

Case studies are seen as an essential element of this research. Benbasat *et al* define case research as a study which "examines a phenomenon in a natural setting, employing multiple methods of data collection to gather information from one or a few entities (people, groups or organisations). The boundaries are not clearly evident at the outset of the research, and no experimental control or manipulation is used" (20). The latter condition obviously raised an issue in this research, in that, while there is no "control or manipulation", the author's involvement could not be described as passive. Apart from this however, the framework proposed by Benbasat *et al* is useful, and offers practical aid to researchers in understanding and implementing case research.

Their advise covers unit of analysis, single versus multiple case designs, site selection, data collection methods, and finally data analysis and exposition. The paper identifies a number of possible weaknesses relevant to case research, including absence of clear objectives, ambiguous data collection, and an absence of the details of data collection methods, and the rare use of triangulation to increase data reliability.

Quantitative Methods

Scientific or quantitative methods are commonly used to test models or hypotheses. They rely on gathering quantitative data usually via questionnaires and subsequent analysis of the data using statistical techniques. The questionnaire usually applies scales or graded responses to each question. Typically, Likert scales are used with five step options from total disagreement to agreement with a given statement.

In order to obtain a more precise response, more refined data is gathered. A typical approach is to use semantic differential pairs (satisfied versus dissatisfied, reasonable versus unreasonable) with graded responses between these two extremes. Quantitative data collected usually includes demographic data as well as the responses to the specific topic under research.

Qualitative Methods

Considerable use was made of qualitative methods during the course of this research.

These methods rely heavily on structured data collection (structured interviews, questionnaires) but the questions and interviews are often open-ended. The subsequent analysis is more deductive and interpretative with theories being developed from the data. Hypotheses are often formulated and reformulated during the analysis, with the data being used to pose and resolve research questions.

Kaplan and Duchon see immersion in the context and a detailed involvement of the researcher in the natural setting as key elements of this research method (21).

The authors go on to identify a number of advantages deriving from the combination of quantitative and qualitative techniques which they experienced:

> qualitative analysis revealed interpretations not initially perceived through purely quantitative methods. Subsequent quantitative analysis showed new correlations confirming the interpretation.
>
> the use of multiple methods increases the robustness of case research through triangulation or cross-validation when different kinds and sources of data converge and are found to be congruent.

Action Research

There are many definitions of action research. Cohen and Mannion describe it as "essentially an on-the-spot procedure designed to deal with a concrete problem located in an immediate situation. This means that the step-by-step process is constantly monitored (ideally, that is) over varying periods of time and by a variety of mechanisms (questionnaires, diaries, interviews and case studies, for example) so that the ensuing feedback may be translated into modifications, adjustments, directional changes, redefinitions, as necessary, so as to bring about lasting benefit to the ongoing process itself" (22).

This definition is enhanced by that of Brown and McIntyre who state that "The researcher/actor, at an early stage, formulates speculative, tentative general principles in relation to the problem that has been identified; from these principles hypotheses may be generated about what action is likely to lead to the desired improvements in practice. Such actions will then be tried out and data on its effects collected; these data are used to revise the earlier hypotheses and identify more appropriate action that reflects a modification of the general principles. Collection of data on the effects of this new action may then generate further hypotheses and modified principles, and so on as we move towards a greater understanding and improvement of practice. This implies a continuous process of research and the worth of the work is judged by the understanding of, and desirable change in, the practice that is achieved" (23).

A problem commonly associated with action research is the weakness in the process of theory formulation, and the approach recommended by Baskerville and Pries-Heje has been incorporated to strengthen the approach taken (24). The most common methodology for introducing scientific rigour into action research is the five phase cyclical approach proposed by Susman and Evered (25).

The fist step, Diagnosis, seeks to identify the problem to be addressed - an important concept here being to interpret in a holistic sense (in relation to the organisation) rather than through reduction and simplification. Based on the initial theoretical framework, researcher and practitioners collaborate on the Action Planning phase, which seeks to establish the target and the approach to achieving the target. This approach is then applied in the Taking Action phase. After the action is completed, the Evaluation phase takes place, which seeks to establish whether the theoretical effects of the action were realised, and the extent to which the original problem was improved by these effects, with care being taken to ensure that the improvements can reasonably be assigned to the theory-inspired action. In the event of there being an unsuccessful application of the theory, it must be amended for the next iteration of the action research cycle. The final activity, Specifying Learning, is usually an ongoing process, although "this learning must be formalised as a concluding stage in the action research cycle".

Grounded Theory

Grounded theory differs from other forms of research in that it "begins with an area of study and allows relevant theory to emerge from that area" (26). Its objective has been defined as the development of "a theory that is 'grounded', that is, closely relevant to the particular setting under study. Using the grounded theory approach, the researcher first develops conceptual categories from the data and then make new observations to clarify and elaborate these categories" (27).

According to Strauss and Corbin, analysis in grounded theory research is composed of three groups of coding procedures, open, axial, and selective coding (28). The goal of open coding is to reveal the essential ideas found in the data. This requires each discrete incident or idea to receive a label that represents the phenomenon, and that *categories* of concepts also be identified and labelled. The goal of axial coding is to develop a deeper understanding of how the categories relate to one another. This is achieved by connecting categories in terms of a sequence of relationships, which are then referenced against the data for validation. The objective of selective coding is to develop the theory that best fits the phenomena being studied. This calls for the development of a narrative that reveals the central phenomenon being studies, and validating its relationships to other categories.

Limitations in integrating the grounded theory and action research have been identified by Baskerville and Pried-Heje (29). In particular, they point out that the narrative (essential to selective coding in grounded theory) is to an extent already pre-defined in action research. They state that "typically a grounded theory approach is unfettered by such initial predilections and is initially oriented towards exploratory discovery of this first theoretical framework". The authors do acknowledge however that considerable benefit can be achieved by combining the two approaches, and this was found to be the case with this research.

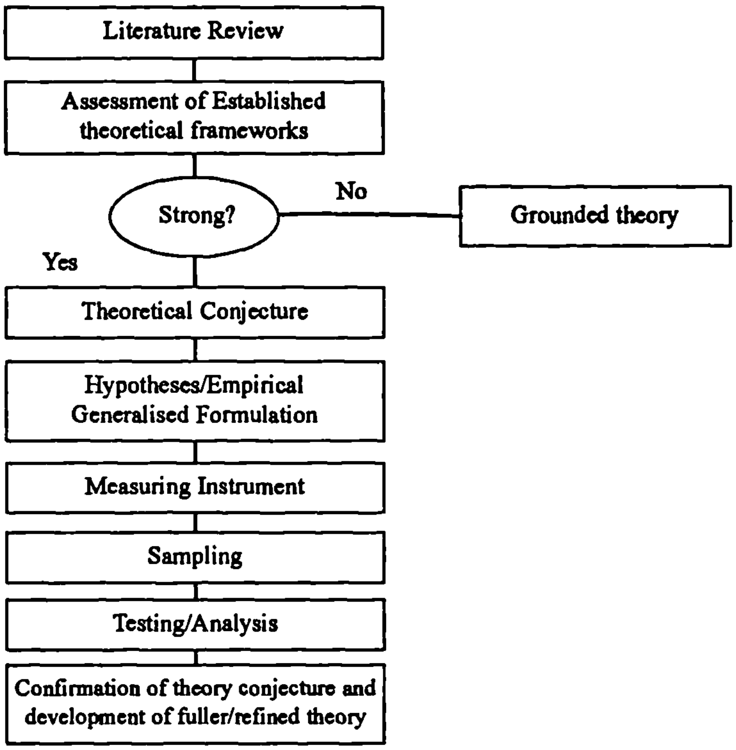
2.2 Definition of selected approach

The overall approach to the research will therefore closely resemble that as defined by Remenyi and Williams in Fig. 2.3., but action research predominated for the following reasons.

- It is based on the researcher initially formulating a theory or hypothesis to be validated/improved in practice
- It focuses on a specific problem located in an immediate situation
- It is an iterative process which seeks to apply the findings of field research and other forms of research to improve practice
- It allows an active role for the researcher

However, as Bell has stated "classifying an approach as quantitative, qualitative, ethnographic, survey, action research or whatever, does not mean that once an approach has been selected, the researcher may not move from the methods normally associated with that style (30). Each approach has its strengths and weaknesses and each is particularly suitable for a particular context. The approach adopted and the methods of data collection will depend on the nature of the inquiry and the type of information required".

Fig. 2.3 Steps in the Research Process (Remenyi and Williams)



Summary

In summary therefore, it can be said that rich resources of research methodologies are available, and elements of most were incorporated into the chosen methodology as appropriate. The first issue to be established was whether a need for a new theory was required. Once established, this was validated and refined in a field setting. While action research has been the predominant approach adopted, it was supplemented with other forms and methods as demanded by the circumstances. The research approach recognised the requirement for frequent cross-referencing of findings between individual managers and companies. In other words, specific research findings, or conclusions drawn, in one company, were to be applied in others, with the intention of establishing the scope for general applicability.

Chapter 3. Historical Development of the IT Payback Paradox

3.1 Introduction

The rate of growth of information technology (IT) in the thirty years or so leading up to the mid 1990s has been extraordinary, in its sustained growth surpassing by many orders of magnitude that achieved by any other technological advance throughout history. The rapidity of this growth, and its related impact on business and organisational structures, may have contributed to what many see as an inadequate return on the related IT investments and thus on investment appraisal methods. A wide range of phases has been identified in tracing this evolution, from as few as two to as many as seven (31). For the purposes of this review, a four-stage model is proposed, as it accurately reflects the significant changes, and parallels the four decades of the time frame under review.

3.2 The Four Phases of Evolution

3.2.1 Phase 1: The automation of existing departmental functions (1960s)

3.2.1 (a) Characteristics:

Computers were acquired to automate specific business or organisational functions, usually those involving large volumes of repetitive transactions. Typical applications would be payroll or order processing. Individual departments would specify their requirements, which would in turn have been derived from goals assigned to these departments at corporate level. A vast gulf separated the IT (or Data Processing, as it was known then) staff from their colleagues in the user departments. Not alone was there a physical separation, but DP staff knew virtually nothing about business issues, while users knew even less about computer matters - and were not encouraged to (32). This inevitably led to misunderstandings on both sides. The author has attended numerous meetings characterised by furious disagreement and mutual recriminations. It is little wonder then that disappointment was frequent, but one advantage was the simplicity which followed from the fact that the computer system invariably replaced its direct manual equivalent - even the forms and reports were often replicates of the manual versions (33). Despite the mutual incomprehension therefore, once IT understood the mechanics of the task, the development of the resultant system was comparatively straightforward.

3.2.1 (b) Investment appraisal techniques

The objective of the systems deriving from this process would be to eliminate paper-based processing (or more accurately, replace this with its computer-based equivalent), reduce headcount, while increasing speed and accuracy. These factors would form the justification for each project, with the most significant being direct, tangible savings (34). In Ford at this time only direct costs such as headcount or overtime savings would have been accepted, and other companies with whom Ford had backup site arrangements had similar policies.

It was relatively easy to establish what processes could be automated, and the impact of the automation in terms of savings. Thus a company's payroll may have been handled by ten clerks, many of whom would work overtime at peak periods. Automating the process could mean that the manpower requirements might now be reduced to two clerks. The salaries, indirect labour costs (pensions, insurance, office space etc.) and overtime payments of the eight eliminated clerks would represent the system savings.

Cougar has shown how the corresponding cost of developing and running the resulting computer system were less rigorous (35). Even companies with sophisticated financial procedures such as Ford confined costs to the direct and indirect labour expense associated with development, operations, data preparation and input, together with direct material costs such as stationery and (if applicable) punch cards. Amortising the hardware, relating anticipated savings to opportunity cost, or evaluating in time/value terms (Internal Rate of Return, Net Present Value) do not seem to have been widely taken into account when cost justifying a project during this Phase. These could have been indirectly addressed by the utilisation of a "throw factor", i.e. a factor by which savings must exceed costs. In other words, a 40% throw factor (a common figure in the author's experience) would require savings of £140,000 where development and operational costs were estimated to be £100,000.

Conventional appraisal standards applied to hardware purchases. In fact, exhaustive tests were performed on comparative hardware. Processor speeds, storage device capacity, input/output performance, and printer throughput were examined in detail, but individual application proposals were assessed in basically crude terms. The whole emphasis was on minimising cost (36).

3.2.2 Phase 2: Cross-departmental integration of applications (1970s)

3.2.2 (a) Characteristics:

Instead of automating existing business functions as would have been the case at Phase 1, Phase 2 systems integrated data, and sometimes processing, between different business functions (37). For example, a single Creditor file might support the accounting, inventory control and purchasing functions, a development facilitated by advances in database technology at around this time. The drawbacks occasioned by the gulf between systems and user staff was by now being seen as an impediment, and improvements began to be identified. For example, the author attended a Hoskyns systems analysis training course in 1972 which incorporated the "revolutionary" concept of the systems analyst not just understanding the details of the task to be automated, but of the user's business objectives as well.

Considerable benefits resulted therefore. These primarily related to more consistent data, a reduction in manual input requirements, and reduced storage requirements due to less duplication. The capacity to integrate data from different departments resulted in a major leap forward in terms of management information systems. For instance a sales report could advance from reporting actual sales figures to incorporate cost (and therefore gross profit) data, as well as information on stock levels and outstanding purchase orders (38).

There were disadvantages however. Phase 2 systems, being more complicated, incurred longer development lead times and increased incidence of software and operational errors. Of greater long-term significance, their increased size and complexity resulted in reduced flexibility, which in turn reduced the capacity to adapt to business change. There was also some resistance to sharing data between departments. Osterman showed clear direct benefits from the introduction Phase II systems, with investment appraisal methods being well understood (39). Primrose also supports this position (40).

3.2.2 (b) Investment appraisal techniques

The main change from Phase 1 in assessing project feasibility appears to have been an increased application of discounting techniques which addressed the concept of the time-value of money. This could have been a reflection of the high inflation rates which applied in the 1970s, and/or a realisation that more sophisticated techniques were required. (Discounted Cash Flow Return was introduced as an element of IT investment appraisal by Ford of Europe in 1982.) These however failed to address some new issues which Phase 2 introduced.

For example, while the shared database referred to may have saved some time in eliminating the duplication inherent in the previous configuration, the main benefits might have related to the provision of more consistent and up-to-date data - benefits which did not lend themselves as easily to quantifiable analysis. Organisational matters, the ownership of data, faint blurring of functional boundaries, and information as a justification in its own right were identified as issues to be addressed, and at about this time at Ford the concept of "intangible" benefits was introduced. At Ford (and there is little reason to believe this was the exception), "intangible" was a dirty word in terms of identifying benefits. This was due mainly to the widescale practice on the part of users of using the intangible portion of the cost justification exercise as a balancing figure to build to the required value. This discrediting of the intangible concept was unfortunate, in that the emerging potential for real, if non-quantifiable organisational benefits was undermined.

Nonetheless, although now less clear-cut, it was still possible in most circumstances to quantify direct savings. Weill stated that "this type of IT investment is quite well understood, and a history of successful implementations exists in most sizeable firms" (41). The process was facilitated to a considerable degree by the introduction and rapid growth of what is known today as packaged software. Software was developed by third parties (often the suppliers of the hardware) on the basis that most companies had basically similar processes, particularly in areas such as accounting, and that once developed, such an application could be sold on many times. Many of the uncertainties which bedevilled in-house software development were now eliminated, and although the implementation of bought-in software introduced a new set of problems, it seems likely that in terms of performing a cost/benefit analysis, it represented an advance.

3.2.3 Phase 3: The growth of personal and distributed computing (1980s)

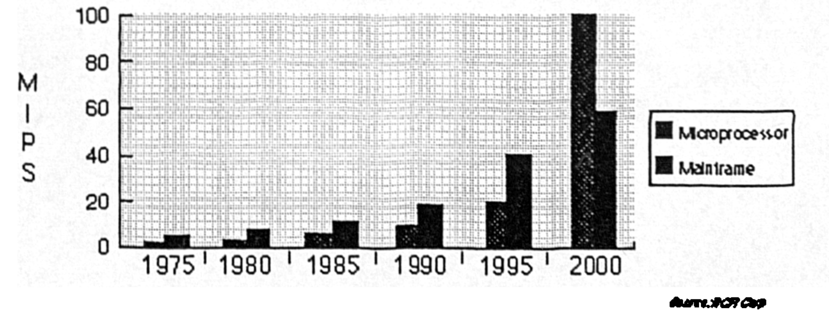
3.2.3 (a) Characteristics

Phase 3 is represented by the explosive growth in personal and distributed computing which followed the introduction of the PC by IBM in 1981. Prior to its introduction (i.e. at Phases 1 and 2), users with "dumb" terminals could access computer-based data, but even the simplest tasks called for the mastery of a complex (by the standards of non-technical staff) set of commands, although the introduction of question-by-example (QBE) at this time did partially address this problem. Mainframe and mini-based systems punished mistakes, and the lack of sympathy for end users amongst IT professionals was legendary. The introduction of the PC calls to mind W.B. Yeats "all is changed, changed utterly, and a terrible beauty is born".

Few could have imagined the extent of the changes its introduction would trigger off, least of all IBM. Its policy of making the operating system available on competitor's hardware meant that so-called clone manufacturers were in a position to produce machines much more cheaply than IBM. As prices plummeted, users, hardware manufacturers, software developers, and training specialists leapt onto the PC bandwagon. Everyone, it seemed, was either using a PC, or was in the PC business. This was understandable, as Phase 3 presented the following:

Quantum leap in processing power and the price/performance ratio. Computer power exceeding in many ways that of 1960's mainframe could now be had for less than £10,000. Systems previously ruled out because of lack of capacity at the central computer facility now became feasible. The relative growth in the performance of mainframes and PCs is shown graphically on Fig. 3.1., which shows that a single microprocessor will outperform a mainframe in terms of MIPs (millions of instructions per second) by the year 2000.

Fig. 3.1 Relative Performance of Mainframes and Microprocessors: (Tapscott and Caston)



Ready-made software: Users, hitherto used to lead times of up to a couple of years, could now buy off the shelf software packages, which often possessed superior functionality to those produced in-house. Spreadsheets in particular afforded users dramatically improved independence in data manipulation and report generation.

Cheaper software: The cost of software underwent a similarly radical transformation. Typically, an integrated accounting package, which may have entailed up to ten or even twenty man years to produce in-house, (in financial terms, maybe up to half a million pounds) was now available for a couple of thousand pounds. The relative price movements for computers and other forms of expenditure, based on Loveman's figures (Lovemen, Gary, "An assessment of the Productivity Impact of Information Technologies") are shown on Fig. 3.2.

Fig. 3.2 Deflated Price Movements for Computers (Loveman)

Year	Price deflator for computers	Price deflator for others
1950	93046	25
1955	32543	29
1960	11739	35
1965	3715	35
1970	1264	41
1975	637	58
1980	167	84
1984	63	105

User-defined systems: Within a couple of years of the introduction of the PC, simplified application development tools, designed for inexperienced computer users, became available. It seemed that the days of users specifying their requirements and being disappointed with the results from the systems staff might be over. In addition, the plummeting costs of processing power and disk storage reduced performance degradation which could have resulted from unprofessional development techniques.

Faster and better information: Monthly reports, presented three weeks after the event on continuous stationery, began to look hopelessly passé in the new world of the PC. Instantaneous screen-based inquiry became the order of the day, and easily-used report generators enabled customised, attractive printouts to be obtained and modified without difficulty.

Staff mobility: The (almost) homogeneous world of the PC created a new breed of company-independent computer operators. The hitherto crippling dependence on specialists of one sort or another was vastly reduced. For example, a company running one of the well known PC-based accounting packages would find it relatively easy (and inexpensive) to find staff experienced in the operation of the computer and the software package used.

3.2.3. (b) Investment appraisal techniques

Phase 3 saw the first real attempts at breaking away from accounting-based investment criteria. This stemmed from the growing realisation of their inadequacies, and what progress there was stemmed largely from the academic and research institutions. Cost/benefit analysis was enhanced by the concept of Direct Labour Cost Substitution, published by AT Kearney in 1987 (42). This method, based on industrial engineering techniques, while perhaps more suited to Phases 1 and 2, did provide a more reliable framework for assessing labour substitution benefits. Michael Porter's Value Chain Analysis went much further, in that it sought, by identifying and isolating the key components of a firm's value creation process, to break away from the straight-jacket of cost/benefit analysis (43). Even though some critics argue that Porter had only repackaged traditional value added techniques, his work did result in IT investments being seen in a new light. One of the most influential writers of this period was Paul Strassman. His book "Information Payoff" (44), published in 1985, broke new ground by shifting the focus for payback from technology to organisational, cultural and people issues. Cathleen Curley of North-eastern University and John Henderson of Boston University introduced the concept of differing payback at different levels of the organisation - the individual, the division, and the corporation (45).

These new approaches all had one characteristic in common - they recognised that the new business environment called for an evaluation framework above and beyond the traditional accounting based techniques in general use. Evidence of their successful application in a business environment remains thin however. Two causes appear to predominate in explaining this. The first is that a convincing, practical methodology had not at this stage been developed. Schwartz and Sassone cite examples of companies which tried up to a dozen different methods for evaluating the benefits of an office automation project, with minimal success (46). The authors add, quoting a 1986 survey of the Fortune 500 companies by *Executive* magazine, that almost 89.5% of executives encountered "great difficulty" in quantifying intangible benefits, while 61.2% found that "uncertainty of benefits" made justification methods hard to apply.

Research by Meyers and Boone also supports this position (47). The second cause derives from the dominant influence of the finance department on IT issues which, though now in decline, applied during Phase 3 (48). The natural tendency in the finance department would be to apply techniques which were familiar and consistent with investment appraisal in other areas. This tendency was reinforced by the difficulty in evaluating intangible benefits, and the consequent disillusion among executives (49).

The net result was that while new approached had been developed, few had been successfully applied in practice. A 1995 research paper from Remenyi and Williams on this issue as it applied in the UK finds that "in spite of the fact that a wide range of techniques specifically intended for the evaluation of IT projects are available, very few had been used (50).

3.2.4 Phase 4: IT as an enabler of business process reengineering (1990s)

3.2.4 (a) Characteristics:

Phase 4 represents today's environment, and is characterised primarily by the transition from IT applications *per se* to IT as the enabler of new ways of doing business, underlined by the virtual equalling of hardware costs by organisational costs - a dramatic transformation from Phase I (51).

Reflecting the recognition that the business environment is being fundamentally changed by IT, there is increasing emphasis on viewing business as a series of processes, which can and must be fundamentally redesigned and simplified by the imaginative application of IT. This approach is commonly referred to as business reengineering, business process redesign, and other designations, but all have as their core the need to view business in terms of processes, and to seek improvement through fundamental redesign, frequently using IT as a key enabler (52). The concept is treated in detail in Chapter 8 and from this the following definition of a process is taken:

"A process is a series of tasks designed to achieve an added-value objective". Typically the tasks involved in a process will transcend departmental boundaries, and quite possibly organisational boundaries, i.e. they might extend beyond the individual firm. A typical process would be order fulfilment, which would not only involve tasks from internal departments such as sales, finance and distribution, but quite possibly take in links to suppliers and/or customers as well. For a process-based organisation to be effective, the process team must not be subject to the control of whatever department he or she might be in. The "first loyalty" is to the process. Thus a credit controller in the finance department who is a member of the order fulfilment process team should be more concerned with meeting customer orders (within specified guidelines) than with the minutiae or procedural niceties of credit control.

The implications for IT applications are immense. Speed and flexibility in applications development, in the context of end-user empowerment, are paramount, which in turn means that existing "legacy" systems act as a liability. The requirements of speed and flexibility call for the widespread application of rapid-development software tools (53). The resulting applications are likely to have a shorter life (Chorafas cites applications in financial services with a lifespan as short as a few weeks, although these would hardly be typical) (54). The twin demands of rapid development and short lifespan call for an appropriate underlying systems architecture. These may have to contain much of the functionality which in earlier Phases resided at application level, such as database access, screen and report builders, and structured queries. This functionality is likely to be built on server technology, whereby different data types will be managed by dedicated servers, and by object-oriented tools, such as those for building the user interface (55). These issues are covered in more detail in Chapter 10.

3.2.4 (b) Investment appraisal techniques

The currency of the issue, the speed of technological change, and the fundamental transformation of the business environment mean that the development of appropriate appraisal techniques in Phase 4 is very much an ongoing process. Much progress has been made at an academic and theoretical level, but, as stated in 1.2.3, evidence of practical application of such techniques remains slim. Probably the most important characteristic of this Phase is that, despite the fundamental change in the role and capacity of IT, the commonest criteria for investment appraisal remain financial, or occasionally, as research by Peat Marwick has shown, unsubstantiated "acts of faith" deemed necessary for competitive reasons (56). A review of the literature has failed to show up any indication of advanced techniques being applied on a widespread basis, and research by Willcocks and others reveals an absence of practical application of new measures (57). Commenting on a survey undertaken by the Kobler Unit which showed that only 16% of managers rely on rigorous methods to evaluate IT benefits, the authors suggest that the explanation for this low figure is due at least in part to the fact that "the majority of managers simply do not have adequate tools at their disposal" (58). Research by the author in a range of private firms, government departments, and semi-state companies (i.e. those in which the state has a controlling shareholding) revealed that the dominant criteria were financial, or the feeling that "we must have it, irrespective of the cost justification".

In effect therefore, the finance-based measures used in Phase 1 continue to predominate in relation to Phase 4 investment decisions. Given the scale of change in the period under review, the effectiveness of such measures, and their relevance in the new business environment, must be open to question. Many of the findings from research undertaken by the Diebold Research Group support this contention (59). This organisation conducted an investigation between 1988 and 1991 into how companies justify and measure IT investments. They may be summarised as:

- Although it is used by a very high proportion of the companies surveyed, cost displacement and avoidance are no longer adequate grounds for assessing investments. Factors such as revenue generation, organisational and strategic issues are generally more important.

- benefits can be optimised by reengineering business processes. This in turn requires companies to evaluate their investments in terms of increased effectiveness and business value added, rather than purely financial considerations.

- The most realistic appraisals incorporated a balanced approach, technology and business considerations, hard and soft benefits.

- The survey established that the most successful investments appeared to have rigorous performance measurement systems directly linked to business consequences

3.5 Some speculation on the causes of the IT payback paradox

Over the time frame spanning the four Phases there has therefore been a confluence of two powerful forces for productivity improvement, viz., an increase in IT expenditure greatly exceeding that of investment in general, and dramatic improvements in the price/performance ratio of computers. Had the IT spend remained constant at its comparatively low level, the price/performance ratio (which enabled not just the same, but much more to be achieved at a much lower cost) in itself may not have given rise to significant productivity gains. But the figures cited in (1.2.1) suggest the spend on IT has been enormous. By all logic, productivity gains should have been huge. But, as was suggested in that section, productivity gains have been minimal, at a little over 3% as expenditure grew by 350%.

One important factor to be noted here however is that measures of GNP and other forms of productivity seldom if ever quantify the value of information per se. Thus for example, Keen cites a bank which spent $1 billion in developing a database, yet that database has no official value in the bank's accounting records (60). Similarly, it will not appear in GNP or most other productivity figures. Such computations represent another part of the problem being addressed here, being geared for a different age, an age when physical goods and services represented wealth. Thus the apparent proof of the payback paradox is in itself a partial reflection of that paradox, and is treated in more detail in the next section.

3.5.1 Phase 1

It appears likely that payback generally was achieved on applications during this Phase. This claim can be made as systems were straightforward and discrete, being almost invariably justified on the basis of cost savings. The evaluation procedure was not complicated by issues such as business alignment, controlling the chaotic end-user computing environment, or the need to implement business process redesign, as was the case with later Phases. A review of the literature suggests that the Ford Motor Co. procedure used would have been fairly typical for this time (61). This consisted of a relatively simple cost/benefit analysis, confined to the specific application. The benefits would usually relate to personnel savings, either headcount (a favourite term at the time) or overtime savings. The costs were categorised as development and operational. Development related to systems analysis and programming time, and operational costs related to computer operators' time to run the application, consumables such as stationary, and a notional cost allocation for computer processing time. A contingency figure was built in to cater for inaccurate estimates.

The big impediment would have stemmed from the primitive development environment at this time compared to that applying today. For example, the author developed applications at this time on a mainframe with 64k of memory, and over 200 disk drives of 500k each. An average PC today would have capability hundreds of times greater than this. (See 3.2.3) The effect of such restrictions was that applications had to be developed by way of writing a large number of small programs - a recipe for errors and problems of integration. Furthermore, the memory limits frequently called for programs, or parts of programs (called sub-routines) to be written in the Assembler language, coding for which is slow and difficult. Another common problem arose when errors were detected at testing time or initial "live" running. As individual programs were usually written close to the limit of available memory, correcting such errors often resulted in memory being exceeded. This in turn called for either a substantial rewrite of the program(s), or an additional program for the suite. Either way, the risk of system failure was increased. Compiling and testing facilities were primitive, which frequently resulted in programmers taking the "it will be all right on the night" approach to modifications. These factors, compounded by the general lack of practical experience (computers were new, there was little or nothing by way of collective experience), meant that the risk and incidence of operational - particularly hardware - failure was high. On balance it appears that during Phase 1, the simplicity of the applications more than compensated for the difficult development environment.

3.5.2 Phase 2

The Complexity Issue

The integration of what had been standalone applications in Phase 1, together with those coming on-stream in Phase 2, called for new skills in managing the cross-functional implications of the integration. Even though major advances had been achieved in database technology and performance early on in Phase 2, their practical application was limited due to lack of familiarity on the part of systems staff, and an existing applications portfolio based entirely on an earlier development environment. The major part of the task therefore related to integrating Phase 1 standalone applications with one another, the remainder to integrating Phase 1 and Phase 2 applications.

This called for a new range of issues to be addressed. The author recollects the following issues at Ford and the Cadbury backup contingency site: (62)

(a) Consolidation of files: There would normally have been several customer and supplier files.

(b) Consolidation of coding structures: Code for employees, customers, components, may have been in a different format in each application.

(c) Reconciliation of data definitions: Typically, a sales figure may have included VAT in one application, excluded it in another.

(d) Identification of potential update/concurrency problems: During Phase 2, particularly at the earlier stages, the bulk of applications were processed in batch mode as distinct from real-time. This could give rise to operational errors when both applications used the same master file.

(e) Introduction of new levels of security and access control: With cross-functional systems, security, access control, and confidentiality become more complex and fluid, calling for more than technical skills for resolution.

(f) Implementation of enhanced audit capability: Cross-functional systems called for more complex and intelligent audit procedures, and systems audit trails. This had to be accomplished while maintaining adequate levels of confidentiality.

(g) Resolving issues of data ownership: The integration of applications introduced potential inter-departmental conflicts over data ownership.

This is by no means an exhaustive catalogue of the issues involved in integration, but it serves to establish the potential complexity of the task. Strassman has used the laws of complexity to underline how rapidly problems of integration can assume enormous proportions, as shown on Fig. 3.3. Taking his figure of 1,000+ for the number of information systems in a typical major corporation, the scale of the problem can be seen, and must surely have been a major factor in at least partially offsetting the advantages of integration and continued improvements in the price/performance ratio (63).

Fig. 3.3 **Complexity and Integration**

No. of Information Systems	No. of Integration Tasks
2	2
3	6
4	12
5	20
6	30
10	90
100	9,900
1,000	999,000

Compounded maintenance and operational costs

The compounded nature of costs related to systems maintenance and operational support was one of the most profound and influential determinants of IT performance during Phase 2 (and indeed during later Phases). Peter Keen has highlighted the full significance of this phenomenon, and described it in terms of great clarity (64). In essence, his message is that every dollar spent in systems development, will automatically generate \$0.4 in maintenance, and \$0.2 in operating costs in each of the following five years. Therefore a \$1 million expenditure will generate follow-on costs of \$600,000 per year to support the investment. The full implications of this will be reviewed shortly, but first the numbers used to support such a dramatic claim must be questioned.

The first reservation would be that different industries, and different companies within the same industries, could have widely varying ratios between development costs and subsequent operations and maintenance. The second, based on the author's experience, supported in recent discussions with other IT Managers, is that data relating to operations and maintenance costs for individual applications would have been very hard to isolate. Keen addresses the first by stating that the figures are based on his work undertaken over many years in a range of industries, and, given his reputation, this must be credited with great weight. He does acknowledge that wide variances exist between companies, but that the figures quoted represent a broad average. He addresses the second reservation in a somewhat circular way, by in effect claiming that as such figures are not tracked, he cannot be disproved!. While not having work papers available with which to substantiate Keen's figures, in the informal discussions with DP Managers referred to above, the consensus was that the figures mentioned were not out of line.

(The IT Manager at Nissan Ireland, in a recent conversation with the author, recollects that up to the mid 1980s, maintenance and operations costs on their in-house mini-based applications consumed virtually the whole IT budget).

This scrutiny was deemed necessary, as Keen's thesis, if true, goes some way towards explaining the lack of payback from IT investments during Phase 2, and indeed the impact continues to be felt through the persistence of so-called "legacy systems". The full implications, analysed in the context of four alternative strategies, are brought home in (Figs. 3.4 to 3.7).

Fig. 3.4 Strategy 1: Maintain a Level Budget of $40 Million

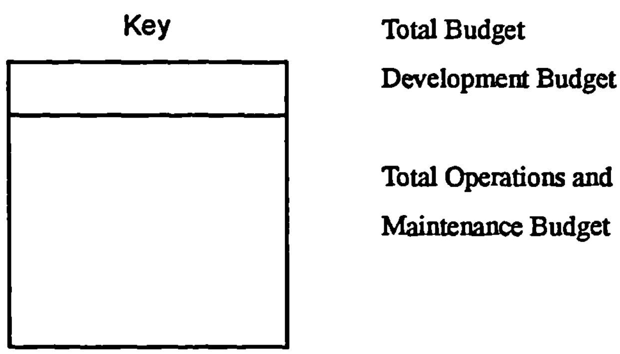
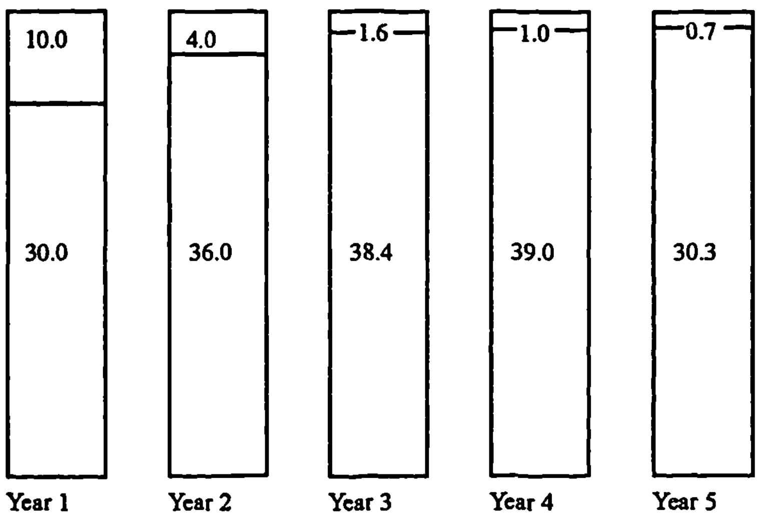
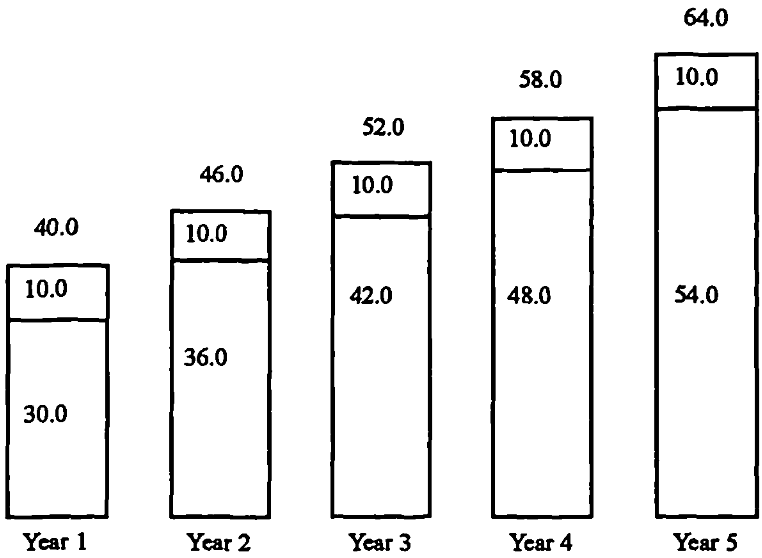


Fig 3.5



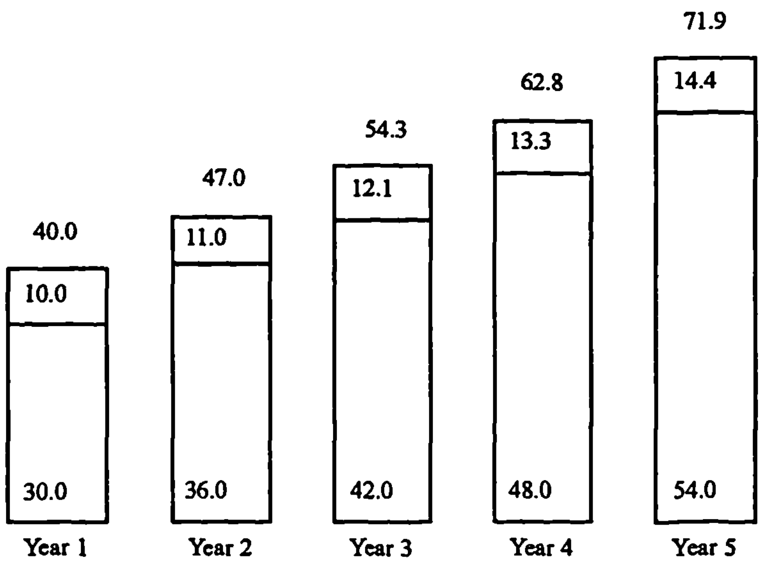
Result: Development has been cut by 93% but the overall budget remains the same.

Fig 3.5 Strategy 2: Keep development level at $10 million



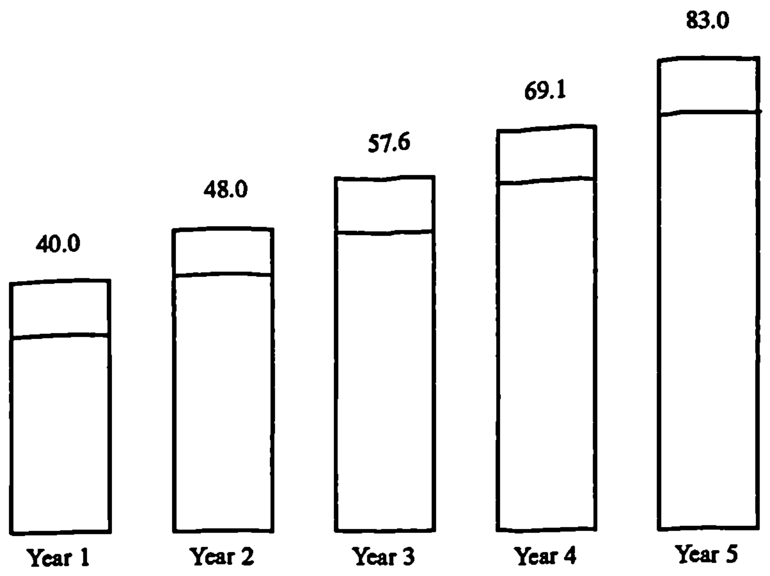
Result: Compounded budget growth of 15% per year, but no extra development. Development has dropped from 25% of the total budget to 18%.

Fig 3.6 Strategy 3: Grow development by 10% a year



Result: Compounded budget growth of 18% a year for just 10% growth in development. Development now 20% of total budget.

Fig 3.7 Strategy 4: **Grow development by 20% a year**



Result: Keeps development at 25% of total budget and rate of growth of both development and total at 20%. This provides a steady balance between total budget growth and development growth.

Strategy 1, which maintains a consistent overall budget, will virtually eliminate new development over a period of five years. Increasing or even maintaining expenditure on development would increase the budget by orders of magnitude over the same period. Keen puts the natural rate of growth for applications development at 20% annually - on face value a not unreasonable figure. The implication therefore is that this demand cannot be met without enormous annual increases in IT spend. It partially explains at least why the compounded rates of expenditure of 15% referred to above have not resulted in appropriate financial returns.

While Keen does not offer a definition of maintenance, his inference is that it is essentially unproductive. This is not always the case, in that some of what is called maintenance could be classed as a form of development. For example, the provision of a new report for an existing system might come under the maintenance umbrella, but in reality it is a form of development. Nonetheless, it can be said that maintenance is generally understood to refer to tasks such as changing tax rates and pricing calculations, adapting systems to new platforms, integration issues etc., and it is undoubtedly this classification to which Keen refers. While necessary, the work involved cannot be said to be adding to the functionality of the system as originally specified. There is also the point that such a level of maintenance means that new developments can only be undertaken in the context of major increases in budgets.

Strategic Alignment

Strategic alignment is defined in a Butler Cox Foundation Report as "a state of harmony between the goals and activities of a business, and the computer systems that support them" (65). The report adds that it is self-evident that strategic alignment is a goal worth pursuing, as "the most advanced and sophisticated computer systems are of no value unless they deliver business results, which implies a degree of strategic alignment". In Phase 1, strategic alignment was not an issue, as computer systems were largely confined to automating existing manual tasks. These tasks, be they payroll administration, order processing, or inventory control, were undertaken by clerks until the computer systems were ready for introduction. This would normally be followed by a period of parallel running between the manual and computer systems, during which the output between the two were reconciled, until such time as the manual system was allowed to lapse. In such circumstances, strategic alignment was not an issue - the systems were demonstrably meeting a specific business need. This assumes of course that the manual work being replaced was not itself obsolete.

Phase 2 was different. As businesses and their environments change, so does the need for the supporting systems to change. Manual methods were flexible in this regard. Clerks were merely instructed to undertake their duties in a way which addressed the new requirements. The situation with computer systems was very different, especially Phase 1 and Phase 2 systems. These could not be adapted or modified easily. The main reasons were those of complexity (often deriving from social or political initiatives) and compounded maintenance and operational costs described above, and other factors would have been inadequate structures for handling the cross-functional aspects of Phase 2 applications, as well as inadequate (by today's standards) software development, in that applications were invariably developed using third generation languages.

Strategic alignment thus became a problem, and it was a serious problem, although the full implications do not appear to have been fully realised at the time (66). Businesses were changing, but the capacity of the computer systems to support the change was inadequate. This was a key consideration in explaining why IT expenditure continued to grow during this period.

3.5.3 Phases 3 and 4

In that the installed base of Phase 1 and 2 systems would have carried over into Phase 3, and indeed still exist in large numbers in Phase 4, many of the factors outlined above as contributing to the Payback Paradox would have carried over into the later Phases as well. This would be particularly true for strategic alignment, which assumes increased significance, and poses additional challenges, as the rate of business change increases. However, factors specific to the latter two Phases have emerged.

Information Management Issues

(a) *Data accuracy:* Tibbets and Bernstein see difficulties in balancing end-user flexibility with the need for data accuracy and security (67). While many of the data controls and verification procedures demanded by data processing administrators were seen by users as bureaucratic and unnecessary (and may have been, to some extent), these controls generally ensured a fairly high standard of data accuracy. Accepted norms of development ensured that systems were designed to reconcile input, processing and output, often by program to program verification techniques. Erroneous transactions were omitted from the run, and returned for correction.

PC users were invariably unfamiliar with such requirements. Applications were developed in an unstructured manner, enabling inaccuracies to creep in. Once in, the lack of a structured environment could result in the erroneous data infecting existing valid databases.

(b) *Data Integrity:* The causes of the data inaccuracy referred to above were basically the same as those giving rise to problems of inadequate data integrity. Lack of training in system design standards resulted in the same data entities being identified as different, and different entities being regarded as the same.

Referring to user-developed database and spreadsheet applications, Bray suggests that "these are usually riddled with inaccuracies, and the data they hold is either so disorganised that nobody else can find it, or so insecure that it may fall into the wrong hands" (68).

(c) *Duplication of development effort:* The new free-for-all placed users in the position of being able to provide for themselves those long requested and rejected applications so important to their work. In the rush of development that followed, duplication of development effort, and reinvention of the wheel became common (69). Typically, different sections of the sales, purchasing and accounting functions might have need of a flexible inquiry system for the product master file. Each would develop its own, independently of the other. While each might require minor differences, many of the basic requirements would be similar.

(d) *Misapplied usage of development tools:* One of the most welcome arrivals in Phase 3 was the rich body of easily-used development tools. Spreadsheets, Fourth Generation Languages (4GLs), report generators and PC databases represented development functionality unknown in the mini/mainframe world. Undoubtedly, untold numbers of highly beneficial applications were produced which, in the absence of these tools, may never have seen the light of day (70).

But in the hands of inexperienced users, these tools could be applied with less than impressive effectiveness. The National Institute for Management Technology repeatedly encounters, in the course of consultancy assignments, instances of spreadsheets used for word processing or stock control, relational databases constructed without relationships or indexes.

(e) *Reduced systems security:* It is bordering on self-evident that security in a PC environment is below that applying with centralised systems. The inevitable rework and erroneous information deriving from this would have given rise to business inefficiencies. As Tibbets and Bernstein put it "a vandal with a screwdriver (or a data-sniffer or virus-infected utility) can cause terrible mischief" (71).

Operational inefficiencies:

(a) *Business disruption:* The introduction of PCs, a network, and new software, in a department of inexperienced users, causes considerable disruption, the scale of which may have been underestimated (72). Direct time loss arises from training related to PCs, networks and new software products. A lot more time, by many orders of magnitude, is lost in trying to apply the principles learned on a practical basis in the work environment. More insidiously, by impacting on the quality of service, this disruption would have had an adverse impact on relations with other departments and, directly or indirectly, the customer,

(b) *Purchasing Inefficiencies:* The concept of the end-user handling his or her own purchasing had an attractive ring to it. An end to bureaucratic red-tape, the direct user knowing the exact requirements, closer relationships between the user of the software and the supplier, quicker response times. Many, if not all, of these perceived advantages were, and still are, genuine, but they have a downside:

Lack of integration: This was undoubtedly the most significant consideration. In fact, the full impact has yet to be fully identified. The lack of integration could occur at a relatively low level, for example, in users acquiring different word-processing packages. The transfer of an employee to another job might require retraining in a new package, with the associated costs in terms of lost time and direct training expense. Viewed from the perspective of the total organisation, such costs could be significant (73).

Foregoing of bulk purchases: The cohesion associated with centralised data centre purchasing does not apply at end-user level. This resulted in the loss of, or significant diminution in, the opportunity for bulk purchasing discounts. Such discounts can be very significant. For example, the unit cost for a site licence for a leading spreadsheet package would represent but a fraction of the cost of the same package purchased on a once-off basis (74).

Additional Factors for Phases 3 and 4

(a) *User expectations:* The transfer of computing power to the user, and the resultant proliferation of packaged applications software and user-friendly development tools gave rise to unrealistic expectations. "If I can buy an integrated accounts package for under £1,000, and can develop a respectable budget variance analysis in a few days on my spreadsheet, how on earth can the IT section tell me I must wait two years for my application, and pay £20,000 for it?"

Such a refrain will be familiar to anyone who has worked in IT in recent years. It was difficult to counter without appearing to be negative and nitpicking. Systems department either had the option to stick to their guns, and relinquish further their control of application development (and their share of the IT budget), or try to accommodate unrealistic user demands. Too often, they chose the latter.

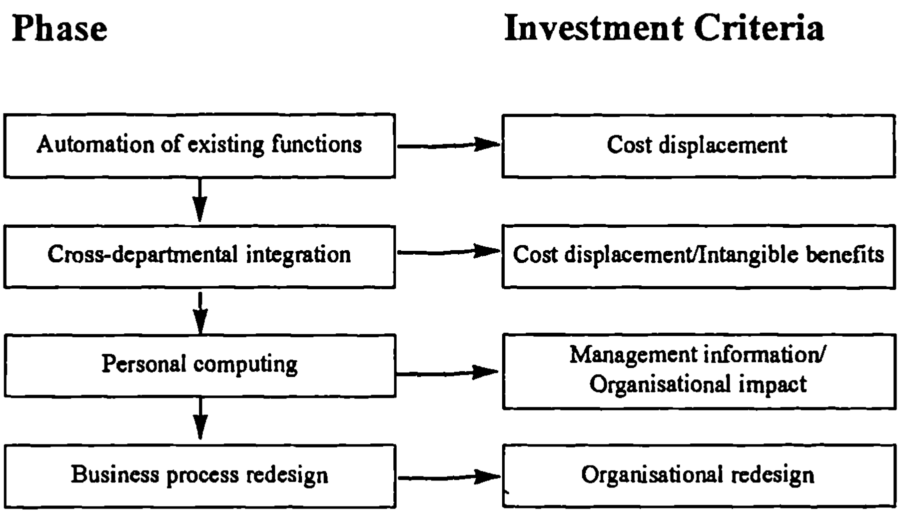
(b) *Peer pressure:* While surveys are likely to understate the extent to which purchasing is governed by what the other person is doing (who will be happy admitting to that?), there can be little doubt that IT usage by other companies, and colleagues within the same company, plays a role in purchasing decisions.

Many organisations seek out what they perceive to be industry norms as a yardstick for the level of IT investment. Ratios such as IT spend per employee, IT spend as a percentage of sales, or profit as a percentage of IT expense have been used as a basis for identifying the "right" level of expenditure. Various reports, and annual special editions of *Information Week* and *Computerworld* seek to establish a causal relationship between such ratios and business performance. But such ratios form an inadequate rationale for purchasing decisions.

Regarding peer pressure from colleagues, while quantitative evidence is not being provided, such pressure is self-evident. More powerful PCs, smart new utility programs, the latest version of software packages, laser printers, all become necessities, not luxuries, when the people across the corridor are using them, and extolling their virtues over coffee. When the competition has the latest in IT, the pressure becomes all the greater.

A summary of investment criteria over the four phases in shown in diagramatic form in Fig. 3.8.

Fig. 3.8 Investment Criteria by Phase



Summary

The scale of change experienced over the four Phases has been nothing short of dramatic. The cumbersome standalone applications of Phase I, developed and operated in the glasshouse atmosphere of the computer room bear little resemblance to today's norm. Major milestones along the way have been the virtual demise of said computer glasshouse, and its replacement by the freewheeling world of distributed computing and users developing their own applications. Of major significance in terms of IT investment appraisal techniques has been the sharp decline in the control of IT activities by the finance department. With this has come a loosening of the heavy emphasis on accounting techniques to evaluate and measure investments, which in turn has provided the opportunity for others to develop more imaginative and flexible methods.

The technology (more correctly technologies) have undergone an even more dramatic transformation than the applications. Astronomical improvements in the price/performance ratio in hardware and communications technologies and major advances towards open standards have made technically and/or economically feasible innovations which would a few decades earlier been inconceivable as business options. These developments have been paralleled by a transformation of the workforce from blue collar to white collar, from manual worker to knowledge worker.

These decades demonstrate their share of paradoxes. For instance, on the one hand business has throughout the period maintained a constant demand for improved systems support. Yet business has consistently failed to adopt new technologies. Some figures estimate that 80% of all code written in 1992 was COBOL, the epitome of old technology. Yet this only serves to underline one of the biggest problems in the field of IT investment appraisal - how to capitalise on the new IT environment while safeguarding existing IT investments. This issue is likely to represent a major problem for many years to come.

The biggest paradox of all however must be the low level of IT payback when related to the improvements in the technology, and the persistence of organisations in applying appraisal techniques which were appropriate only for earlier Phases. This perhaps can be at least partly explained by the rapidity and scale of the change, but it is not unreasonable to assume that, while historical developments may have moved too fast to enable new methods to be adopted, as Chapter 4 seeks to demonstrate, conventional accounting-based techniques on their own are not only inadequate in the new environment, but may in fact be counterproductive.

Chapter 4.
A Review of Conventional Finance-based Evaluation Methods

4.1 Introduction

The history of business computing through the transition from Phase 1 to Phase 4 has already been delineated. The nature of this transition, specifically the movement from cost displacement applications to those providing information, rendered the evaluation of payback from IT investment less clear-cut. As was also demonstrated, the growth rate in productivity lagged sharply behind the growth in IT expenditure. It was further shown that finance-based appraisal criteria still predominated in the investment process. This suggests that a detailed re-evaluation of finance-based criteria is called for.

4.2 An Evaluation of Traditional Finance Based Techniques

The following is a review of the strengths and weaknesses, advantages and disadvantages of the most common finance-based techniques applied in investment appraisal. The critiques are drawn from a range of sources (75).

4.2.1 Payback

Payback identifies the length of time it takes for a project to pay back the initial investment, and begin generating positive cash flow. Although useful as a back-up for the more comprehensive analyses as outlined below, in it's crudest form it is a very limited method as it does not take into account the overall profit from the project, discounting considerations, the rate of return on the investment or any of the many other factors which determine the economic viability of a project.

Advantages of Payback

(a) It is easily understood

(b) It favours projects that offer large immediate cashflows

(c) By emphasising early deliverables, it offers a means of coping with risk due to increasing low reliability of forecast cashflows as the time horizon increases.

(d) It acts as an effective means of capital rationing when the organisation has a critical need to do so.

(e) Due to its simplicity, it provides a means of decentralising capital budgeting decisions by having IS staff and other non-finance staff screen proposals.

Disadvantages of Payback

(a) It ignores all cashflows beyond the payback period

(b) It ignores the time value of money

(c) It does not distinguish between projects of different size in terms of investment required.

(d) It can be made shorter by postponing the replacement of older hardware beyond the appropriate replacement date, thus giving rise to misleading interpretations.

(e) It emphasis short-term profitability to the exclusion of long-term profitability.

(f) It ignores salvage value of equipment.

4.2.2 Net Present Value (NPV)

In the context of NPV calculations, net value refers to the benefits of the system minus the costs. To refer to the present value of a project is to say that the values have been subjected to discounting. The principle of discounting, or the time/value of money is concept is fundamental to both NPV calculations, and to those for Internal Rate of Return, as discussed in 3.2.3. An understanding of the concept is essential when assessing the merits and demerits of NPV and IRR.

Advantages of NPV

(a) It does not ignore any periods in the project life, or any cashflows.

(b) It takes into account the time value of money - the main advantage.

(c) It recognises the benefits of early cashflows over later ones.

(d) It permits actual versus projected tracking during the life of the project

Disadvantages of NPV

(a) It is more difficult to apply than Payback.

(b) Being more difficult than Payback, it is less likely to be used by IT and non-finance staff.

(c) Unless modified by conversion to uniform annual equivalents and converted to profitability index, NPV will give distorted comparison between projects of unequal size and/or unequal economic lives.

4.2.3 Internal Rate of Return (IRR)

The internal rate of return, sometimes referred to as the discounted cashflow return (DCFR), represents the interest rate at which the NPV is 0, that is, it measures the actual percentage rate of return the project will achieve. Many companies have what is known as a "hurdle rate" which is the minimum rate of return

Advantages of IRR

(a) It does not ignore any periods in the project life, or any cashflows.

(b) It takes into account the time value of money - the main advantage.

(c) It identifies a rate of return percentage which management can assess against other business options.

(d) It favours early cash flows over later ones.

Disadvantages of IRR (DCFR)

(a) It is more difficult to determine than either Payback or (in the common event of non-uniform cashflows) NPV.

(b) It does not distinguish between projects of different sizes and/or different economic lives.

4.2.4 Optimising the use of Payback, NPV, and IRR in evaluating IT projects.

There are several ways of looking at this issue.

The Payback Period measures the length of time it takes to recover the investment. Depending on the particular circumstances of a company, this could be the most critical condition. It is certainly an important consideration, and as shown, can be refined by using the system to discount the cash flows, and by basing the Payback Period on the capital cost of the project. Nonetheless, used in isolation, the Payback Period does not address either the amount of profit from the project, or the real rate of return. Once a project's net cash flows have been discounted, the NPV measures the profit generated in terms of present values. In other words it measures it in absolute cash terms.

The IRR on the other hand measures a percentage rate of return.

So the Payback Period measures the time it takes to recover the investment, the NPV represents the amount of money at present values a project will earn, and the IRR measures the effectiveness of the use to which the original capital was put, i.e., the rate of return. For a single project therefore, both NPV and IRR will give the same answer as to whether a project is viable or not, because if the NPV is positive, it must have an IRR greater than the discount rate used in calculating the NPV.

Assuming a choice of projects, an unlimited supply of capital and other resources to undertake all the projects on hand, it is valid to select all projects with a positive NPV. The same result would be achieved by selecting all projects with an IRR greater than the discount rate used in calculating NPVs.

In the more realistic situation of inadequate resources for all the projects available, the most effective use of capital must be sought. This is done by obtaining the IRR for each project, and ranking them in order of return. Starting from the one with the highest return, each project is selected until available capital is used up.

The value Payback Period, NPV and IRR analyses should not be overstated merely because they appear to demonstrate precision. They should be seen as an essential first step, but no more.

4.3 Efficiency versus Effectiveness

The accountancy-based methods described reflect their Industrial Age origins, when benefits were measured in terms of enhanced input/output productivity - the factory paradigm. Strassman describes the wide range of elaborate attempts to apply these techniques to evaluating white-collar productivity (76). These include accounting and financial data, counting office forms, stopwatch studies, task sampling, computer monitoring of keystrokes, standard costing techniques. These all suffer from a fundamental misunderstanding of what constitutes white collar productivity, which can be measured in such terms only when it directly parallels factory style operations, for example, repetitive activities such as invoice production and pay calculations.

But, as has been seen in 3.2, these tasks are now seldom undertaken manually, resources instead being directed towards providing faster and better data, decision support facilities, enhanced communication, and other Information Age benefits. This represents the classic mistake of equating efficiency with effectiveness. An example of this confusion is provided by Meyers and Boone, in which the authors cite a study by Booz Allen which attempted to quantify management productivity. The study classified as "unproductive time" such activities as "time spent outside or within a building or waiting for meetings to start or a machine to become available"(77).

This represents a classical Industrial Age, task-based approach to productivity. No attempt is made to evaluate the possible insights or inspiration a manager may derive from taking a walk outside, and can it be said that informal discussions with ones' colleagues before or after meetings can on occasion be more productive than the meeting itself? Another good illustration is that by Strassman, who cited the example of a customer complaints system which greatly reduced the number of follow-up calls. This had the effect, based on strict accounting measures, of reducing productivity, as measured by number of calls handled by operator. Effectiveness improved, but efficiency disimproved (78).

This underlines the proposition that conventional measurements may not only be inadequate, but may in fact be misleading when it comes to establishing what make an operation perform more effectively.

4.4 Misleading Capital Values

Traditional accounting is not geared to capitalising applications development or databases. This reflects the discipline's original purpose, which was to measure physical systems for delivering products and services. Vast sums of money may be spent on building such applications and databases. Keen cites the example of a bank which spent close to $500 million to create its software applications, and well over twice that to build up the related databases. Neither of these assets, central to the operation of the business, and costing over $1.5 billion, appeared in the bank's balance sheet, since the accounting systems treated them as expense items (79). When one considers that a newspaper title has been deemed acceptable for capitalisation, it seems strange that valuable, long-term software resources disappear into the black hole of expense accounting.

This question is not one of semantics. Even though they may not qualify as capital for tax purposes, capitalising these assets can have significant impact. The most important, as Keen points out, is that senior management, through being appraised of the scale of the investment, may apply appropriate investment management resources to it. Keen shows that the amount of time spent by senior management on IT issues bore no relation to the ratio of capital tied up in IT. Including applications software and databases should have this effect of making them apply more attention to IT issues. In any event, as Vincent shows, information now meets most of the qualifications as an asset as demanded by the US Financial Accounting Standards Board (80).

4.5 Bias against long-term investments

Accountancy-based methods have a built-in bias against long terms investments, because the longer it takes for the financial returns to be made, the lower the present value (NPV). Whereas this is correct in terms of the time-value of money, it tends to present potential investments in IT infrastructure in a relatively unfavourable light. This militates against the formulation of well structured IT strategic planning (see Chapters 6 and 9). Even at the applications level, short term considerations are likely to predominate, and, as Nolan and Norton and others have shown, benefits often take longer to achieve than was originally estimated (81).

4.6 Lack of integration

As IT becomes increasingly integrated into all essential business processes, and end user involvement continues to grow, (see 3.4 and 3.5) few applications are truly standalone, most integrate with the infrastructure, or with other applications in some way, if only to share a database or a printer via a network. As a consequence, evaluating potential investments as discrete, standalone events, as accountancy based methods inevitably must, is likely to provide an incomplete, or even misleading, result.

4.7 Encourages "Mycromyopia"

The terms mycromyopia was coined by Paul Strassman, and refers to the tendency to derive satisfaction and comfort from "perfection in managing details" (82). While Strassman's focus was on office efficiency in general, the same principle applies. Accounting-based techniques bias the evaluation towards the tangible cost elements, and those benefits which lend themselves to easy measurement. In other words, because something can be readily quantified it will be included, if it cannot, it will be excluded. This need not be a problem if it is recognised as such. However, the sheer volume of statistics, and the precision with which they are applied, can generate a spurious appearance of reliability. As Willcocks and Lester have shown, this can, and does, translate into an equally spurious feeling of satisfaction amongst those responsible for the evaluation process (83). Key areas of business value-added such as customer satisfaction, quality, speed to market, and competitive response will never be approved on the basis of measures which narrow in on the directly quantifiable.

4.8 IT Budgeting

Traditional accountancy based techniques fail to address the complexities associated with IT expenditure and cost control, just as they do with investment appraisal. This stems from three main sources:

(a) IT seen as overhead rather than capital

Most literature on the subject today suggests that, apart from costs associated with large hardware items, in budgeting terms, IT is treated as an overhead rather than as capital (84).

Among the drawbacks cited by Earl arising from this are a tactical rather than a strategic outlook, a short-term "stop/go" approach to expenditure, and an emphasis on controlling costs rather than managing benefits (85). Earl also provides a taxonomy for mov-

ing from managing costs to managing benefits.
(b) Failure to incorporate full lifetime costings for IT

As has been shown in earlier, Keen has demonstrated the impact of maintenance and operational costs in the years following the introduction of an applications. Each dollar of development cost will result in $0.4 maintenance costs, and $0.2 operational costs in the ensuing years. Thus, in static budgetary conditions, these costs will inevitably form an ever growing proportion of total IT costs, progressively squeezing out development funds within a few years (86). By treating the development cost as overhead, this trend is likely to be missed. Furthermore, the time-lags associated with realising IT benefits are not adequately catered for through the medium of monthly/annual costs budgeting techniques.

(c) By being rigidly focused on departments and divisions within an organisation, traditional budgeting techniques fail to incorporate the large and growing proportion of IT costs incurred by end-users. Keen quotes a 1987 *Datamation* study, which estimated that 40% of IT costs were not included in the IT budget, and Computerworld provides similar figures (87).

4.9 Depreciation Implications:

The practice of depreciating assets is a normal and necessary part of financial accounting, which seeks to continuously represent the value of a firm at a realistic level. It also has tax implications, in that depreciation charges can normally be offset against tax liabilities. The normal practice is to depreciate assets in line with statutory (taxation) requirements. For instance, where the asset category is permitted to be written off for tax purposes over five years, a firm's accounting systems will reflect this. This process is singularly unsuitable for handling IT assets, due to the unprecedented rate at which upgrades are being introduced, and prices are falling (see. 3.2.3 (a)).

This is not just a matter of paperwork, it has implications for the effectiveness of a firm's operations for the following reasons:

(a) Using statutory depreciation criteria, the book value of a firm's assets will be distorted. As 50% of new capital investment may now be IT related (see 1.2.1), this distortion could be quite significant. The alternative is to keep in effect two sets of books. While the practice of keeping two sets of books (one for the tax man, the "real" ones for private use) is hardly an innovative concept, it does impose operational constraints and inefficiencies.

(b) Accountants are reluctant to dispose of an asset below its book value. But if, as has been shown, this may not reflect the market value, IS managers can be constrained from implementing needed upgrades. Frank Dzubeck, President of Communications Network Architects of Washington DC is quoted as saying "It's a Catch 22. But that's what accounting is all about. It's a joke" (88). This is somewhat unfair on accountants, who in these circumstances may not only have to adjust current and prior financial statements, but also arouse the interest of the revenue authorities, who look askance at the disposal of assets before their depreciation date, particularly when the disposal incurs a book loss. The effect however can be to impose constraints on IS operational operations which are not based on factual criteria.

Summary

This somewhat brief review of conventional accounting based appraisal methods shows them to be inflexible, geared towards assessing efficiency rather than effectiveness, incapable of incorporating intangible or amorphous benefits, and weak on integration. They will generally favour the safe, short-term investments as against the longer-term strategic and infrastructure investments. Yet these investments may be essential for business success. They also neglect the element of risk, which, as will be seen later, can be a major consideration. These qualities remarkably parallel those which gave rise to the present poor performance of IT as detailed earlier in this Chapter. This is to be expected, as in both cases they reflect their origins in hierarchical, task oriented, organisational structures which are unsuited for today's business environment. These concepts are treated in greater depth in Chapter 9.

This is not to say that such methods do not have a role. Return on investment, based on realistic cost benefit analysis, is, particularly when discounted, a vital component of most evaluation exercises. But it is only one component. The problem today is that the formalised evaluation process in so many organisations continues to rely on these methods alone.

Summary of Part I and Introduction to Part II

The introduction to the research theme focused on the radical business, economic and indeed social changes which characterise the latter years of the twentieth century. These changes, which have frequently been driven by dramatic advances in the price/performance ratio of information technology, have raised questions as to the suitability of conventional approaches to business organisation, which demand that companies be flexible, competitive and customer-focused. The period under review also witnessed a fundamental change in the role of information technology, from transaction processing to catalyst for business transformation. The importance of IT in the new business environment was underlined by its growth in expenditure, which greatly exceeded that of non-IT products and services.

Despite the increased importance of IT, and the fundamental way in which it was changing the business environment, traditional methods for evaluating IT investments still applied. This was all the more surprising in that, despite the quantum improvement in the price/performance ratio, available statistics suggested that IT investments were failing to provide a satisfactory return. The following paradoxical situation thus applied:

- business organisation was being transformed, at least in part, through a huge and rapidly growing investment in IT
- this investment was failing to generate appropriate returns while investment evaluation techniques were largely the same as those which applied in an earlier and very different time.

The research objective therefore was to develop a framework for IT investment appraisal appropriate for present conditions, and to test the *acceptability* and *suitability* of the framework (in view of the low take-up rate of modern techniques) in a number of medium-sized organisations. The research methodology was to develop an initial theoretical framework based on existing methods and a review of the literature and practice, and to apply this in a number of operational settings which would be used to identify further refinements. The operational research was to be primarily by way of action research, but was also supplemented with other forms and methods as demanded by the circumstances.

To fully understand the current impact of IT, a review of its evolution, from raw transaction processing to enabler of competitive advantage and catalyst for business redesign, was deemed essential. This evolution, spanning thirty years or so from the mid 1960s, was classified by way of a four-stage model, as it accurately reflected the significant changes, and parallels the four decades of the time frame under review. The review traced the evolution from the transaction-processing departmental systems of the 1960s, through the inter-departmental systems of the 1970s, the dramatic impact of the introduction of personal and distributed computing in the 1980s, into the business transformation role of the 1990s. Despite these advances, so-called legacy systems, old applications developed using second generation programming languages such as COBOL, continued to dominate in terms of staff employed and code written. This served to underline one of the biggest problems in the arena of investment appraisal - one which is likely to represent a problem for many more years - namely how to capitalise on the new IT environment while safeguarding existing IT investments.

The investment appraisal techniques which predominated in each of those periods were also reviewed. It was clear that the dramatic technical and application advances were not matched by correspondingly sophisticated investment appraisal techniques, which remained largely finance-based in practice, notwithstanding the availability of much original research. In the light of this, a critical review of the main finance-based techniques was undertaken.

The review identified a number of characteristics of these techniques, which were shown to be inflexible, geared towards assessing efficiency rather than effectiveness, incapable of incorporating intangible or amorphous benefits, favouring the safe, short-term investments as against the longer-term strategic and infrastructure investments - which may be essential in the successful deployment of IT. While these techniques were useful as a *component* of the appraisal process, used alone they were not only inadequate, but would in all likelihood give rise to misleading results.

With the research gap clearly identified, the stage was now reached where theory building could begin. The starting point was a review of the literature to identify the latest research and techniques. While a considerable degree of research was available, much of it was focused on particular aspects of the problem, rather than on developing comprehensive frameworks. The main objective was to establish what the researchers and practitioners saw as the key considerations or criteria to be applied in the IT investment appraisal process. For each of the methodologies reviewed, the key criteria were identified, and, were assigned a grade reflecting the relative importance of their role as assigned by the author/researcher.

However, it must be emphasised that the objective was not just to identify those key determinants, but to also identify, primarily for the benefit of the participants in this research, but also for future practitioners, the key issues associated with each of the determinants . These issues are examined in detail in Chapters 6 through to 11, with particular emphasis on their suitability for incorporation into the eventual framework. This phase concludes with the development of a proposed framework designed to form the basis of the field research.

Part II Theory Building

Chapter 5. Review of Current Approaches to Investment Appraisal

Introduction

The central role now played by IT in most organisations, and the difficulties in achieving appropriate levels of payback, have given rise to a considerable degree of research in the area. Much of the work however focuses on particular aspects of the problem, rather than on developing a comprehensive framework for investment appraisal. The following methodologies are critically reviewed, and the key underlying investment appraisal concepts, either implicit or explicit, are identified.

5.1 Nolan & Norton 'Grey Cell Analysis'/IBM Strategic Investment Methodology (SIM)

Nolan & Norton developed an approach to IT investment in the mid 1980s which sought to identify poor practices in investment appraisal (89). Among the main problems identified were:

- Taking the short term view, which forces managers to think tactically rather than strategically, and which fails to take into account that many of the benefits from IT investments take a number of years to come to fruition.

- Expensing investments in software. On the basis of their research which showed only 20% of companies treating software development as assets, Norton & Nolan claim that viewing IT as an expense places an undue focus on short term issues, and fails to adequately represent the business value of such investments in the balance sheet.

The authors developed what they called the 'grey cell analysis' approach to identify the most valuable investments for a firm. This was taken up by IBM and formed the basis of their Strategic Investment Methodology (SIM). The technique is based on three matrices. The first relates to a company's business functions and the critical success factors (CSFs) for that company. Each cell contains the value that the function contributes to the particular CSF. For example, the supply and distribution function may be assigned a value of 4 out of a possible 5 in relation to the CSF 'improving customer relations'.

The second matrix assesses in what function IT investments should be made, based on how well the investment can leverage that function. Grey cell analysis/SIM categorises investments by type, for example Professional, systems which support key individuals, External, systems which link to outside organisations, customers, Infrastructure, systems which support applications throughout the firm. Thus Professional systems in Marketing might be allocated a score of 5, as they are seen as vital in leveraging the marketing function.

These two matrices are combined to create a third matrix which shows the strategic importance of each type of investment in each function. The cells with high values - the grey cells - identify the types of applications in each function for which investment is appropriate.

5.2 Clemons and Webster's Seven Step Approach

E.K. Clemons and B.W. Webster provides a seven step approach to IT investments, with particular emphasis on strategic investments (90). Prior to defining the approach, the limitation of finance-based techniques are underlined, particularly for strategic investments. The authors first propose three steps to be taken before the investment decision is taken:

Rank Alternatives: It is difficult to compute accurate estimates of business benefit, investments, particularly for strategic IT investments. Accordingly, a form of ranking may be more appropriate, based on detailed analysis of alternatives.

Use financial analysis where appropriate: As referred to earlier, the limitations of finance based techniques are identified. However, the authors do see a role for sensitivity analysis where critical variables can be identified and quantified. This helps deal with risk and uncertainty. Even though the limitations of traditional finance-based approaches are made clear, the authors see a role for sensitivity analysis, especially where critical variables can be quantified.

Balance many forms of risk: The authors identify five forms of risk: financial, technical, project, functionality and systems-related risk. They recommend that these be evaluated separately, with the capacity to manage the most severe risk being the main determinant in the investment decision.

The authors go on to make recommendations for optimising the investment once the decision is taken. They recommend non-technical resources should be leveraged (on the basis that the technology on its own seldom produces competitive advantage), that the possibilities of co-operative development with other companies (even competitors) should be investigated, and that, given the turbulence and unpredictability of today's business environment, that maximum flexibility should be preserved for future courses of action, which they see as a function of strategic systems and the underlying architecture.

5.3 Peter Weill: Justifying Infrastructure (Architecture) investments

Peter Weill, in a 1992 study explores the justification of investment in infrastructure (91). He defines infrastructure as "the base foundation of IT capability budgeted for and provided by the information systems function and shared across multiple business units or functional areas. The IT capability included both the technical and managerial expertise required to provide reliable services". Chapter 10 will seek to demonstrate that this definition is consistent with the term "Architecture" as used in the course of this research.

Weill sees infrastructure investments as particularly difficult to justify, as they seldom provide direct or immediate benefits, and such benefits may be dispersed throughout the organisation. His research identified three perspectives commonly applied for investing in infrastructure.

An independent perspective, which views an investment in infrastructure as a utility, being built by the IS function as an enabler or enhancer of their own operations. It takes little or no account of the firm's strategic direction.

A reactive perspective is where an infrastructure investment is taken in response to a particular strategic initiative. While it may be based on a strategic initiative, its value is measured by the immediate benefits it produces in relation to that initiative.

An interdependent perspective is taken by organisations that develop and enhance their infrastructure in line with the firm's strategies. Costs associated with these investments are seen as a business investment, rather than as an expense item, as would be the case with the other perspectives.

Weill therefore identifies three types of expected benefit:
1. Improved productivity of user groups
2. Leveraging other IT investments made by user groups
3. Enabling business needs to be made more effective

Weill finally proposes a model for of the role and value of infrastructure investments. In discussing the limitations of conventional finance based measures for evaluation purposes, he shows that these methods are particularly unsuited for assessing infrastructure investments. The model envisages such investments being justified in four ways.

1. Where the investment is firm-wide, it leverages other IT investments made by business units.
2. Where business units make infrastructure investments, they provide benefits such as flexibility, shorter time to market, and reduced marginal costs of other IT investments made by the business unit.
3. Business units can achieve operational benefits from infrastructure investments due to their capacity to enable a process view of business operations to be undertaken (see Chapters 9 and 10), which in turn provides better productivity, fewer defects, and better customer response.
4. Infrastructure investments can also provide direct benefits, especially when applied through the reactive perspective.

5.4 Options Theory

The Options Theory approach which has been developed by John C. Henderson and others has infrastructure investments as its main focus, and is based on financial options theory (92). In financial terms an option is described in the paper as "a contract giving the owner the right to buy or sell a specified amount of assets at a specify price on or by a specific date". In the stock market investors using options may pay much more for a company than NPV calculations would suggest, based on potential for growth or product differentiation, with the option of selling the stock, or buying more of it, as circumstances demand. Similarly, an investment in a new communications system may give the opportunity to differentiate products, or make it easier to abandon unsuccessful ones. A pilot test or prototype is another form of option.

The authors claim that the complex mathematics that underlie the theory enable financial values to be placed on these options. They claim in addition that applying the options theory forces management to address issues frequently avoided or downplayed in conventional investment exercises. They cite time considerations (the longer the option can be deferred is a significant plus, as many investments take a long time to deliver benefits), rigorous risk analysis, strategic alignment (the theory cannot be applied in the absence of corporate strategic assumptions and forecasts). Referring to the limitations of the commonly-applied 'once-off' approach to investment appraisal, they emphasis that their theory sees investment as a process, not an event, as taking advantage of an option call requires constant monitoring of the business environment.

5.5 Sassone's Cost/Benefit Theory

Peter Sassone of the Georgia Institute of Technology has conducted research into IT investment appraisal and measurement for many years, and has developed seven cost/benefits methodologies based on his research (93).

1. Decision Analysis: Applications in this category would typically be a decision support systems (DSS), often rule-based, in the areas of routine decision making, such as that faced by an insurance claims assessor. The assessment method uses operational research techniques as the basis for assessing benefits, and facilitates the comparison of expected benefits with those actually achieved. However, operations research techniques have been shown to be potentially misleading except in factory-style situations, and Sassone himself concedes that few applications fit neatly into this framework.

2. Structural Modeling: This calls for the modeling of a firm's inputs, outputs and processes, and the process changes anticipated from the application being evaluated. The technique seeks to establish a link between the application and the firm's profitability, can identify where the impacts are likely to occur, and may identify unrealistic expectations. The technique appears to have limited application however, due to the difficulty in establishing convincing links between applications and profitability, inadequate source data, and the fact that each model is unique and difficult to explain to senior management.

3. Break-even Analysis: This technique is applied when costs can be accurately quantified but one or more key benefits are intangible - a very common occurrence. It calls for managers to provide a financial value for the intangible benefits. One way involves the manager stating how much he would pay to obtain the system. This is then compared to

the costs, which are known. Given the current poor levels of management understanding of IT benefits, this approach is liable to produce misleading results, and should be used only as an extension to other evaluation methods.

4. Cost Displacement/Cost Avoidance

This represents the traditional approach to justifying investments, and is applicable only for older type data processing applications. Both the costs and projected benefits (typically headcount savings or overtime avoidance) can be determined with reasonable accuracy, and in this sense it is a useful technique both for evaluation and subsequent measurement. However, appropriate new applications are now becoming increasingly rare.

5. Cost Effectiveness Analysis

This is used when it is not possible to measure or assess benefits in monetary terms, but can be in terms management understands and accepts. It calls for specific decision-making factors to be identified, measured, and weighted. While it may be more realistic to rely on subjective management opinions rather than exclusively on financial impact, nonetheless such a lack of rigour must limit its reliability. It is useful for the specific types of project mentioned, and as an additional input where other measures may also apply.

6. Times Savings Times Salary

This is a very rudimentary technique which simply takes the percentage of the employee's salary saved by a system, and applies this percentage to the salary to arrive at the savings. As well as being very basic in ignoring the subtleties of white collar effectiveness, it relies the questionable assumption that time saved has been applied to effective activities.

7. Hedonic Wage Models

Sassone's Hedonic wage model stemmed from his research in 1985 among five companies, which lead him to the conclusion that conventional techniques for measuring the effectiveness of office automation projects were seriously misdirected. The misdirection stemmed from a fundamental misunderstanding of the impact of such projects, which, he showed, had the effect of not just speeding up task processing, but of changing the actual work practices. This in turn resulted in a mismatch between available skills and those required to meet the new working environment. Attempting to capitalise on the new systems with the available skills profile was therefore bound to lead to less than optimum results.

5.6 Keen's End-user responsibility and anchor measures

Make End-users Responsible

This is one of two approaches espoused by Peter Keen (94). The principle cited is that in the light of the movement from centralised data processing to end-user focused applications, it makes sense for the end-users to define and be responsible for the benefits. Keen puts this in the context of the IT planners being held accountable for the cost of supplying the systems, but end users should be responsible for the benefits. He cites the example of a bank which made a major investment in ATM machines. These, and the related software, were implemented on time and within budget, but failed to demonstrate satisfactory returns. While this was partly due to the inadequacies of conventional accounting techniques the primary reason was the failure of user management to implement the relevant cost-cutting measures enabled by way of the new system. In other words, they were not responsible for delivering the benefits.

Introduce Anchor-Measures

An anchor measure is defined by Keen as "an operational indicator of performance that can be used over time to identify .. IT impact". Such measures are based on the overall objectives of the firm, as defined by what managers deem to be important, for instance customer relations, transaction cycle time and employee morale. Underlining the importance of management intent, Keen makes the case that a management team with cost reductions as a priority would use annual cost of servicing a customer or processing a transaction as a suitable anchor measure, whereas if market share were the priority, an appropriate anchor measure for the effectiveness of the investment could be revenue per customer.

5.7 CSC Index Cost/Certainty Matrix

The CSC Index group have developed a categorisation system to analyse which appraisal method should be used for each investment (95). This approach is based on the principle should be evaluated differently. As shown in Fig. 5.1, systems can be evaluated under four classifications.

Systems where the cost is low and the possibility of achieving the benefits high are placed in the comfort cell. More expensive systems with a high degree of certainty of achieving benefits are placed in the confidence cell. Where the cost and benefits certainty are both low, the system should be placed in the caution cell. Finally, where system have a high cost and uncertain value they should be placed in the confusion cell.

Fig. 5.1 CSC Index Cost Certainly Matrix

Cost		Certainty: High	Certainty: Low
	High	Confidence	Confusion
	Low	Comfort	Caution

Guidelines are provided for each category. For instance, systems in the confidence cell are seen as appropriate for conventional finance-based criteria, for those in the caution cell prototypes and experimentation are recommended, while business reengineering is seen as typical of a confusion category investment, for which there is little by way of methodological support.

An earlier report by The Butler Cox Foundation (Getting Value form Information Technology, Research Report 75, June 1990) which now forms part of the CSC Index Group, proposed several measures for evaluating IT investments. The approach seeks to match techniques to the types of projects, and identifies several limitations with existing techniques. It also identifies limitations with more modern techniques such as user satisfaction surveys. The point is made that while many of these techniques represent an advance on those currently applied, they should be used with care. The report pays particular attention here to the use of ratios which relate IT expenditure to other business performance indicators, such as company size, revenue, operating expenses, and non-financial indicators such as capacity utilisation, plant downtime and level of warranty claims.

Regarding the investment process itself, five main business purposes are identified, against which matching IT investments can be categorised and evaluated. The main business benefits from each category are identified, while the main formal aids to investment evaluation, the importance of management judgement and the main aspects of management judgement are then applied to determine the value of the investment. The five categories are mandatory investments, those arising from competitive pressure, investments to improve performance, investments to achieve competitive advantage, infrastructure investments and investments in research. One category (Infrastructure investments) is provided as an example in Fig. 5.2

Fig. 5.2 CSC Index Five Business Purposes

Category	Business Benefit	Main Formal Aids	Importance of Management Judgement	Main Aspect Management Judgement
Infrastructure	Enable Benefits of other applications	Setting perfor Standard and costs	Crucial	Corporate need and benefit long/short term

5.8 Adolph Katz: Seven Point Framework

Adolph Katz proposes a seven point framework for Information Technology Assessment (96). This framework distills an original set of 120 factors developed by Wilson (97).

1. Productivity. Efficiency of expenditure of IT resources.
2. User utility. Customer satisfaction and perceived value of IT services
3. Value chain. Impact of IT on functional goals
4. Competitive performance. Comparison against competition with respect to infrastructure components or business measures.
5. Business alignment. Criticality of the organisation's operating systems and portfolio of applications to business strategy.
6. Investment targeting. Impact of IT investment on business cost structure, revenue structure or investment base
7. Management vision. Senior management's understanding of the strategic value of IT

and ability to provide direction for future action.

5.9 Peters' Investment Maps

Based on research carried out in 50 companies in the UK, Glen Peters of Price Waterhouse recommends the Investment Map approach to investment appraisal (98). He first identifies three types of benefit:

1. *Enhanced productivity*, which includes headcount reduction, working and capital improvements, processing economies, and general efficiency improvements.
2. *Risk minimisation*, which is seen as coming about through improvements in quali ty, minimising accounting losses, reducing risks of failure, shutdown or litigation, greater predictability and consistency of market share
3. *Business expansion*, which is viewed under the categories of consolidating existing markets and creating new opportunities.

Peters also sees significance in what he describes as the "relationship or orientation of the investment towards the business". He identified three broad categories of orientation.

1. *Market influencing initiatives*, such as the improvement of distribution channels, increasing the percentage of repeat sales, and changing customer perceptions.
2. *Business operations*, such as finance, corporate management, order processing and office administration.
3. *Infrastructure*, such as telecommunications, software environment and hardware environment.

Typically, a company with cashflow problems would have an orientation towards business operations, while one planning expansion would have an orientation towards market influencing initiatives or perhaps infrastructure. Peters claims that the fact that "most IT systems cover a range of benefit and investment orientation categories gives rise to the concept of mapping these systems on a grid composed of the two parameters (i.e. benefits and orientation)". This composite map will help identify the extent to which the proposed investment(s) will be consistent with the company's objectives. Peters also provides a framework for scoring the values for orientation and risk.

5.10 Hochstrasser's Migration Path

Beat Hochstrasser offers a framework for evaluating infrastructure proposals and a separate one for non-infrastructure investments (99).

Infrastructure Investments

Hochstrasser's approach here is very basic, in essence proposing that the anticipated business scenario in 3-5 years time should be defined, and an appropriate migration path from the current IT infrastructure established. No tools or steps are provided.

Non-Infrastructure Investments

The author proposes a four module framework for evaluating this category of investment based on research undertaken at the Kobler Unit at Imperial College in London.

1. Corporate Standards for New IT Initiatives

This module is described by the author as "a set of critical success factors that all have to be addressed before the proper process of evaluation can begin". He provides a taxonomy of such success factors, which include having a business sponsor, a clear definition of expected benefits, the establishment of responsibilities for data ownership and provision, and the capacity to avail of existing experience in the company.

2. Awareness of Potential Wider Effects

This module seeks to identify effects not always considered in the IT investment process. Primacy is given to understanding the true nature and extent of IT costs. The author cites research which shows that an average of 30-50% of costs occur outside the IT budget, and that companies consistently underestimate the total costs of IT investments, sometimes to a considerable degree.

Organisational and human costs are seen as particularly important, representing as they do, according to the author, up to four times the costs of the associated hardware and software. Again, a taxonomy of costs is provided.

3. Business Performance Indicators

This module specifies what the author calls "measurable business metrics" (sic). This is based on what he sees as the need for companies to measure more, particularly in the area of IT performance. A number of reasons are adduced in support of this position. The practice of evaluating on a longitudinal basis is recommended. To facilitate the generation of evaluation criteria and to standardise on evaluation criteria, the assigning of proposals into one or other of the following groups is recommended.

- Internal projects, systems introduced to increase a company's internal operating efficiencies. These can be frequently be measured in terms of financial savings, but more frequently in terms of more effective work practices.
- External projects, systems introduced to improve a company's external effectiveness can be measured by such indicators as market share, better or faster market intelligence, or number of customer contacts.
- Cost replacement projects, systems which directly replace an existing cost, such as a workflow system which displaces information intermediaries - a process easily mea sured
- Economy of scale projects, which are systems introduced to enable a company to handle higher numbers of transactions, another easily measured benefit.
- Economy of scope projects, Systems introduced to enable a company to undertake an extended range of tasks. These are much harder to measure, but among the met rics the author recommends are speed of new product development and the provision of new products or services with same level of resources.
- *Customer support projects*: Systems introduced to improve customer service can be measured provided the original objectives are clearly spelt out, for instance faster response time to queries, fewer rejects, faster and more effective service calls
- *Quality support projects*, These systems can easily have metrics applied, such as number of rejects, amount of rework, number of warranty claims etc.
- *Information sharing and manipulation projects*: These systems can be evaluated by "relating the system to a thorough information flow analysis of key business goals". The author recommends the use of a framework developed by the Kobler Unit for this purpose.
- *New technology projects*, Systems introduced strategically to exploit the potential of new technology, for instance home banking or the use of smart cards. The author recommends a strong risk containment strategy for these investments, and suggests

that, with them, metrics may have to be more loosely applied as the potential benefits are likely to be much higher.

4. Project priority value

As the title suggest, the fourth module attempts to assign a relative order of priority amongst projects competing for funds. In doing this it builds on work undertaken in the previous three modules, particularly in regard to the full awareness of costs and risks. To an extent the author sees this module as a form of consolidation of the previous three.

The author envisages each project being evaluated on the basis of a weighting which reflects the company profile. No method for doing this is provided, although, given that the author states it should be based on "the company's overall business objectives" he would appear to have strategic alignment in mind. Four dimensions are provided however against which the investment should be assessed: the primary objectives that the system is designed to receive, the potential second-order effects (Module 2), the strategic integration into both business and technology architecture, and an assessment of the risks involved.

The need for a clear set of corporate objectives is seen as essential for this Module - "Management must agree on a consistent and relevant set of goals and a set of business criteria against which the investment is to be measured".

5.11 Data Information Services Group: Strategic Systems Evaluation

The Data Information Services Group has developed a framework specifically for evaluation of strategic systems (100). Their approach starts by reviewing the determinants of a strategic system's value, and uses them as the basis for making the investment decision. This is supported by the provision of a range of potential risks and advantages of strategic systems: This is followed by a series of investment appraisal guidelines:

1. Investment decisions can be made on a rational analytical basis, even when the numbers required for discounted cashflow analysis cannot be obtained. The primary alternative method recommended here is decision tree analysis.
2. Thresholds established by sensitivity analysis can be used as trigger points for fine-tuning a project once it is initiated.
3. Advantage results from unique assets and resources of the implementing firm. This relates to the extent to which a strategic IT initiative can be replicated by competition.

Specialised forms of deployment, superior human resources skills, and unique advantages for a firm (such as a dominant market position) reduce the risk of replication.
4. Several types of risk exist, and must be recognised early in the evaluation process.
5. Technology investments may have option and timing value, and unanticipated upside benefits. This relates to the application of options theory, which recognises that IT investments provide options for enhancing a firm's assets and resources. The extent of this potential determines the value of the investment under this guideline.
6. Downside risk arises from rejected IT investments, which then become strategic necessities through another firm's initiative.
7. Co-operation may be the dominant investment alternative under conditions of strategic necessity.

5.12 Investment Guidelines: Remenyi et al:

Dan Remenyi et al provide a comprehensive framework for evaluation and subsequent measurement (101). The authors lay particular emphasis on the need to fully understand the meaning of intangible IT benefits before evaluation is attempted. The authors see intangibles comprising an ever increasing proportion of IT benefits, and state categorically that "there are two and only two ways of evaluating intangible benefits". The first is by negotiation, and the second by imputation.

Benefit negotiation is undertaken by asking a user to place a financial value of the benefits anticipated from the investment. To accomplish this, a binary search is recommended. This is conducted on the computer programming model, whereby an extremely low value is first offered to the user, and when this is rejected, an extremely high one is proposed. The binary search is then commenced, whereby the low value is added to the high, and the result divided by two, with the process continuing until an acceptable value is agreed.

An imputed benefit value is described as "one which is derived by calculating the amount a system must be worth to the firm if it is to proceed with the investment and earn its required rate of return". No guidance on relating the benefit to the required rate of return is provided however.

The authors propose a five step investment framework:

1. Select the criteria
2. Associate weights to each criterion
3. Score individual systems in terms of how they satisfy the criteria
4. Calculate a systems rating by multiplying each score by the weight and then summing the total
5. Select the system with the highest score

The evaluation criteria are seen as being different for each organisation, but a number of key issues are specifically addressed.

Strategic Value: This relates to the system's potential to create competitive advantage. Several possibilities are referred to, including Porter's five industry forces, the firm's own value chain internally, or the industry's value chain.
Critical Value: This relates to the system's capacity to enhance the firm's effectiveness in the marketplace.
Operational Value: This refers to systems which enhance the efficiency of a firm's operations.
Architectural Value: This relates to investments which underpin or enhance the capacity of the firm's IT infrastructure, such as transaction processing computers, telecommunications, and corporate databases
Investment Value: This identifies the direct financial benefits from the investment.
Risk Assessment: In referring to the importance of risk assessment, the authors refer to the relative ease of identifying risk, and the relative difficulty in assessing its specific impact on the proposed investment. They provide a very comprehensive taxonomy of risk categories, but emphasise that the upside of risk should also be considered - i.e. that things could turn out better than expected.

A spreadsheet model is provided with which to assist in undertaking the evaluation. This proposes 25 decision variables, of which the 10 most important are to be selected. These variables are then weighted in order of importance on a scale of 1 to 10. The final step is to enter a score of between 1 and 5 to determine the extent to which the proposed system meets these variables. The spreadsheet will then calculate a weighted score for the proposed investment.

5.11 Ward's Portfolio Approach

John Ward takes the portfolio approach to IT investment (102). The development of this approach derives form a number of factors. One relates to the perceived failure to identify the true nature of IT investment contributions. A more important factor is seen as the application by most organisations of a single method to evaluate all IT investments, a method which moreover is based on standard capital projects where benefits are generally well defined.

The portfolio approach is based the 'strategic grid' originally developed by McFarlan in 1984 (103). McFarlan placed system in one of four categories as outlined in Fig. 1. Whilst Ward alters some of the terms and definitions, the matrix is essentially as originally developed by McFarlan. (Fig. 5.3)

Fig. 5.3 Strategic Grid Analysis

Strategic	**High Potential**
Application future access	Applications which may be of future access
Applications critical to sustaining the business	Valuable but not critical applications
Factory	Support

Ward provides a series of seven questions, answerable in Yes/No mode, by which benefits can be identified (Example: *If the development succeeds will it result in a clear competitive advantage for the business? Yes/No?*) and for those responses which are positive goes on to assign them to one of the four categories in the matrix. This exercise should identify the relevant quadrant for the application.

Notwithstanding the value derived from classifying potential investments, some reservations must be expressed on this. The seven questions proposed by Ward are, perhaps of necessity, quite broad in scope. This gives rise to the problem of one question providing a positive response in two or more of the quadrants. In fact, such an outcome is quite likely. As Ward himself points out, this can lead to confusion on objectives and evaluation criteria.

Before finishing with a review of the potential benefits applicable in each of the four quadrants, Ward seeks to establish linkages between this matrix and the five basic techniques of evaluation identified in *Information Economics* (see below) Cost/Benefit Analysis, Value Linking, Value Acceleration, Value Restructuring, and Innovation.

In setting priorities for evaluating the investments, Ward identifies the need for some form of 'strategic weighting'. He proposes that a series of objectives (for instance specific Critical Success Factors, cost reductions) be developed for each application, and a weighting be established, based on a High/Medium/Low application contribution towards meeting those objectives. The need for some form of weightings is underlined by the tendency of, for instance, strategic applications to score heavily on Critical Success Factors, while economic factors will score heavily on support applications. He goes on to identify approaches specific to each quadrant. Many of the criteria overlap, but this is to be expected given the somewhat arbitrary nature of the quadrant classification - for instance the exact dividing line between a between a Strategic and Turnaround application cannot be easily identified.

Ward finishes his methodology with a detailed treatment of the area of risk. The risk factors as they impact on each of the four quadrants are reviewed in depth, and three factors, Time, Quality, and Cost are identified as key to successful projects. A rich taxonomy of risk categories, factors and potential impact is provided, as are detailed questionnaires for evaluating the risk. Much useful material is provided in interpreting the results of these questionnaires.

5.12 Farbey, Land and Targett: Evaluating Investments in IT

In "Evaluating Investments in IT", and in later work, Farbey, Land and Targett look at how organisations make the decision on whether or not to proceed with IT investments (104). The paper, which was based on research undertaken in 16 different organisations, first identifies four objectives which the evaluation process may be seen as serving: The first and most obvious is to establish whether the system may be justified in its own right by meeting company objectives. The second enables a comparison to be made between a number of different projects competing for resources - this on the assumption that the evaluation is based on a common process. The third sees the evaluation process as a possible means of controlling the investment during the development and implementation phases. The fourth objective is to provide a learning mechanism whereby future appraisal exercises may be improved. They go on to identify seven stages during which the project may be evaluated.

The system: The authors suggest that the evaluation method should vary according to the purposes of the system. This must be seen as a questionable assumption, in that it forfeits the element of consistency, making it difficult to compare systems competing for limited resources, and it undermines the organisational learning process referred to earlier.

The authors recommended a five classification approach to the investment process.

Role of evaluation: The role of the evaluation varies according to when it was carried out (the later it is, the more specific the measurement of costs and benefits) and the level of the organisation where it was undertaken (the higher in the organisation, the more strategic the focus).

Decision environment: The historical degree of success or failure had a considerable impact on the evaluation process. The greater the historical success, the more likely IT estimates were to be accepted, while a high proportion of unsuccessful implementation resulted in a much tougher approach by management. Existing corporate culture and procedures also played an important role in defining the choice of evaluation method.

The system: The authors suggest that the evaluation method should vary according to the purposes of the system. They quote the example of a system which is proposed solely as an aid to revenue generation. If the evaluation methodology does not address this issue, the results of the appraisal process may be misleading.

The organisation: The state of the industry (degree of competitiveness, turbulence) and the leadership role of the organisation (whether it aims to lead or follow) are seen as factors affecting evaluation.

Cause and effect relationships: The degree to which it is possible to predict the impact of the proposed project is seen as an important factor. They make the contrast between a payroll system which reduces clerical headcount, and a system which provides management with 'better' information. Clearly, the degree of benefit predictability varies considerably between the two proposals.

In its final section the paper provides what is called 'a speculation' into matching a project with an evaluation method, in the context of the five factors identified above. This is done in the form of five 2x2 matrices, one for each factor. At the end of the exercise these can be overlaid to provide one overall summary matrix. As the authors say, it has no theoretical foundation, and is not based on any testable rationale. Nonetheless when completed it provided what the authors called a 'sensible' choice of evaluation methods for the differing circumstances encountered.

5.13 Parker and Benson: Information Economics

Marilyn Parker and Robert Benson have developed a very comprehensive framework for evaluating IT investment. It has achieved wide usage, particularly in the United States. The theory is propounded in their book *Information Economics* (105), and has been applied and extended by other practitioners in the field (106). Before applying the framework, the authors go to considerable lengths to discover the true meaning of 'value' in the context of information technology, an understanding of which calls for major changes in perspective from both business and IT managers . To establish value requires the identification of the net positive impact of the investment, which is the gross positives (such as improved cashflow, better market positioning), and also the negatives, such as work disruption, training costs, possible staff demotivation.

The main underlying principle of Information Economics is the 'two domain' model of the enterprise, comprising of the *business* domain and the *technology* domain. The authors believe that this model will apply in virtually any organisation, joint stock company, government department, or educational establishment.

5.13.1 Business domain value

The following five classifications of business value are proposed:

Return on Investment, which is the traditional cost/benefit approach, with financial considerations paramount.

> *Strategic Match* is determined by the extent to which an IT investment might support the strategic goals of the organisation. A taxonomy of Strategic Alternatives, and related Strategic Focus measures by which IT might support the Alternatives, is provided.
>
> *Competitive Advantage*: This classification is based on Porter's principles, which relate to the creation of barriers and hurdles against inroads by competitors.
>
> *Management Information Support* is admitted to be the leading example of a hard-to-quantify benefit. Considerable support for identifying net value under

this category is provided, and towards this end three sub-divisions are identified:
1. Traditional management support, which enables managers to control operational areas more effectively
2. Strategic management monitoring, which enables management to monitor the extent to which strategic objectives are being met
3. Strategy and the management of performance, whereby IT can support management in *differentiating* their performance (on the basis that most organisations can replicate the technical functionality of any IT investment).

Competitive Response refers to the need to invest in IT just to *keep pace* with competitive actions

5.13.2 Technology domain value

There is only one category of technology domain benefit, *Strategic IS Architecture,* which, "evaluates the degree to which the project is aligned with the overall information systems strategies".

5.13.3 Business domain risks

Only one business domain risk is proposed, *Project or Organisational Risk,* which focuses on the degree to which the organisation is capable of carrying out the changes required by the project. This is seen to depend on factors such as management support for change and the organisation's maturity level in the usage of IT.

5.13.4 Technology domain risks

Definitional uncertainty assesses the certainty to which the requirements and the specifications can be defined. It also assesses the complexity of the area and the probability of non-routine changes.

Technical uncertainty assesses the capacity of the organisation's technical capacity to undertake the project. Four categories of assessment are proposed, skills required, hardware dependencies, software dependencies, and applications software.

IS Infrastructure risk assesses the degree of additional investment, over and above that defined in the project, may be required for a successful implementation. The authors have in mind factors such as the provision of data dictionaries and additional telecommunications.

5.13.5 Scoring

The allocation by management of scores to the investment criteria described above form an essential component of Information Economics. Even a clearly quantifiable financial payback will go into the framework's calculations as a value judgement. This is required in order to maintain consistency with other variables which are not subjected to quantification, and which are scored on the basis of a value judgement. It underlines an essential element of this approach which proposes that a financial payback cannot in any case be viewed in isolation from other business and technology factors.

The scoring process rests on the assumption "that a strategy is in place.... and that it is clearly stated and sufficiently understood by participants in the scoring process". The need for consensus is emphasised. It is envisaged that while user department managers (the business managers) and technical managers may initially score the project from their own perspectives, 'benefit negotiation' should eventually ensure a final value that is generally acceptable. The scoring range proposed is 1 to 5, but the authors stress that this can be tailored to individual company requirements.

5.13.6 Weighting

The factors described above may vary significantly in importance between organisations. For instance, Competitive Response may be of vital importance to a motor manufacturer, whereas it would hardly be an issue in a government department. Some form of weighting is therefore required in order to align the scores with organisational priorities.

This calls for the need to define *corporate values*, and the authors propose two sources for defining these values and translating them into weights.

<u>Value based on corporate culture</u>

Corporate culture is here defined as "a shared belief system that consists of the organisation's history, beliefs and values. It also embodies the viewpoint and values of senior management". They see the need both to have this culture understood and integrated into the investment decision process. Among the commoner aspects of corporate culture as identified by the authors are:

Organisation: Are reporting relationships hierarchical or flat, responsibilities devolved or centralised?

Systems: Are planning and budgetary processes formal or informal, and monitoring and reward systems participative or dictatorial?

Resources: Are the acquisition and deployment of resources bureaucratic or entrepreneurial?

Culture: what are the decision making processes and attitude to risk? Do long or short term objectives predominate?

Value as a function of Corporate Mission

The organisation's stated objectives are a vital source for allocating weights. This may be obtained from an overall corporate mission statement. The authors cite an example of a university in which IT proposals prioritised on the basis of scoring, had their rankings radically altered when weightings based on overall objectives were applied.

Information Economics sees weightings initially decided on the basis of high medium low classifications, but envisages these being translated into numerical values once general agreement has been arrived at.

5.14 Strassman's Guidelines

In *The Business Value of Computers*", Paul Strassman traces the links (or lack of same) between investments in IT and corporate profitability (107). While he does not propose a formal methodology for investment appraisal as such, he does offer guidelines, which, combined with those in an earlier work (Strassman, P.A., "Information Payoff", 1985) could qualify as such (108). Given his high profile and powerful positions held (e.g. Head of IT at the Pentagon) his contributions merit review.

In his 1985 work, Strassman provides a series of recommendations aimed at executives with responsibility for investment appraisal.

- Link technology investment to strategic goals
- Do not seek specific justification for hardware purchases - rather, see purchases as part of a corporate project to deliver strategic, marketing, or product development advantage
- Apply IT to innovation - do not just automate existing procedures
- Take great care not to underestimate personnel costs
- Insist on plans. These to include details of how people will operate after the system is installed, and will state how the achievement of anticipated benefits can be verified
- Use IT to improve communication
- Choose investments that allow the user to expand the scope of his/her work, not just increase the tempo of work
- Integrate IT specialists into the business domain
- Take advantage of vendors' specialised knowledge
- Measure productivity - benefits will be achieved only when they can be measured. This often requires a new set of metrics

In his later work, Strassman begins by stating that most cost justification exercises fail because they measure in great detail the costs that can be measured, and ignore or downplay those that cannot. He adds that a similar problem arises in the benefits side, where tangibles are emphasised at the expense of intangibles, even though the latter may give rise to the bulk of corporate advantage.

An important element of his proposed approach is the concept that "each investment proposal is unique". He goes on to suggest that the alignment of the proposed system with organisational requirements only comes about with a deep understanding of what is happening within the organisation, and a similarly deep understanding of the impact of the system on that organisation.

He makes the following recommendations:

- The goals are simple and the aims are in sharp focus
- Realistic financial analysis supports the objectives
- The desired improvements are measurable
- There is enough cash to afford to fix what needs fixing

He next addresses the risk aspect, which he sees as vitally important. "Performing risk analysis of computer opportunities is the most urgent challenge facing executives who must make informed investment decisions" (109). He calls for the development of a *risk profile*, which emphasises the need to identify the different levels of risk exposure applying at each stage of the project - a once-off approach to risk is not sufficient.

Strassman identifies four classes of risk (areas of uncertainty), Supplier Costs, Internal Technology Costs, Internal Organisational Costs, and Internal Organisational Benefit, and provides mathematical techniques for minimising uncertainty. These call for extensive use of simulation and probability analysis, and are therefore heavily oriented towards the quantifiable/financial approach, rather than the qualitative. In fact the author goes to some length to debunk some of the better known qualitative approaches.

5.15 Other Frameworks

5.15.1 ISIS

IBM introduced *Information Strategies for Information Systems* (ISIS) in 1987. It is heavily based on Information Economics, incorporating the two domain approach as well as classifications of benefits and risk. It does however go well beyond this, in that the consultancy services offered by IBM take into account the specific financial and technical conditions applying in the firm using the methodology, and also applies benchmarking techniques in the evaluation process. The proprietary ISIS model is a standard Lotus 1-2-3 spreadsheet with data layout templates and predefined computational routines. These routines ultimately provide a series of solutions designed to optimise returns over the ensuing four or five years.

Even though it has been described as "the largest programme ever launched to aid management in evaluating the payoff from computers", ISIS has not been included in the main body of methodologies for two reasons (110). The first is that, as referred to above, it is heavily based on Information Economics principles. The second is that it is a tool, together with related consultancy made available - free of charge - by IBM Marketing staff. This has been described as "IBM's new marketing effort aimed at swaying the expenditures of its customers away from other capital expenditures and towards investments in information systems" (111). As such, its value as an independent methodology must be open to question.

One valuable contribution it did make to the field however was its emphasis on the *resid-*

ual value concept. ISIS models showed that the residual value of an investment at the end of the evaluation period could vary significantly between projects. In *The Business Value of Computers* Strassman says that "the effect of the residual value (calculation) is remarkable. 59% of the value of the benefits accrues from cash flow beyond the planning period. Top management should demand large residual values from well conceived technology investments"

5.15.2 Earl's Four Way Framework

Michael Earl's approach to investment appraisal begins with a comprehensive critique of conventional finance based techniques. He finds that while these have value in certain conditions, using them to the exclusion of other methods can be counterproductive and give rise to misleading results (112). He also emphasises that different types of investment require their own appraisal mechanisms, and provides what he calls a Four Way Framework for this purpose: (Fig. 5.4)

The first column represents the classification of the IT application, while the second suggests the kind of goals that these applications might pursue. The third column represents the nature of each use of the system, while the fourth column suggests the best evaluation technique for the type of project.

Earl provides comprehensive examples of how each element of the framework may be applied. With regard to Competitive Advantage, for instance, he states "the focus is on product-market positioning. Goals relate to external as much as internal operations and the ultimate objective is to cause competitive disequilibrium. Because they are innovative and involve consideration of non-IT factors as well as IT factors, they require commercial judgement for their proposal and support". He adds that some form of strategic analysis is the best way to validate this investment, but that this could be supported by prototyping or by testing (e.g. restricted market study).

Fig. 5.4: Earl's Four Way Framework

AIM	GOALS	NATURE	APPROACH
Productivity and performance	Efficiency Effectiveness	Tangible benefits Clear arguments	Financial NPV
New ways of managing	Change Flexibly	Radical concept Multi-dimensional	Multi-factor Metric
Competitive advantage	Market positioning Competition	Concrete vision Judgement	Strategic analysis Tests
Developing new businesses	Diversification Growth	Business venture Risk & uncertainty	Business case Business plan

5.15.3 Narrower perspectives

A large number of researchers have contributed to the field, but have confined their approach to a small number of factors, or even one factor. Ballantine *et al* have concentrated on the important issue of whether all investments should be evaluated using the same technique, or whether different techniques should be applied according to the proposal in hand, and conclude that the issue remains unresolved, and suggests that "a resolution of this issue can only be obtained by observation and practice" (113).

Several contributions have concentrated on the risk factor in the investment process. Willcocks and Margetts "Risk and Information Systems: Developing the Analysis" (114). The authors provide a framework for addressing risk under external factors, internal factors, content of the proposal, process (such as user training and commitment) and outcomes. In what seems to be the most comprehensive review of the literature on risk, Lyttinen and Hirscheim identified 12 categories which explained information systems failure. Their research suggests that the latest research tends to focus on organisational issues in systems failure.

5.16 Consolidation of principles

This review of the main researchers and practitioners approaches has shown a wide variety of themes and principles proposed for investment appraisal. For example, some approaches address only particular types of investment, as in the case of Weill and Clemons and Webster, who focus on those related to infrastructure. Others, such as Ballantine *et al*, and CSC Index, address the issue of whether the appraisal method should vary according to the investment. Others concentrate on particular elements of the process, such as Willcocks in relation to risk. A few (Parker and Benson, Remenyi *et al*) provide comprehensive frameworks which seek to address all of the relevant issues forming part of the appraisal process.

Overall then, a wide range of issues or principles have been identified in the course of this review, and are summarised in descriptive form in Fig 5.5 and in terms of the importance assigned by the relevant researchers in Fig. 5.6.

Fig. 5.5 Summary Descriptions of Key Concepts

CONCEPT	NARRATIVE
Strategic Alignment	The extent to which the proposed investment supports medium/long term alignment between a company's goals and activities and the computers which support them
Payback	The provision of direct benefits, such as reduced costs and increased revenue
Architecture	The impact of the investment on the company's hardware, software and communications facilities in areas such as integration, future-proofing, flexibility and security
Risk	The risks associated with implementing the proposed investment
Business Redesign	The capacity of the proposed investment to facilitate or impede business process redesign
Weighting	The concept of assigning varying degrees of importance to each investment criterion
Scoring	The concept of management assigning value judgment scores in assessing the potential value of the investment
Probability	The recognition that the chances of some benefits and risks have a greater chance of occurring than others, and the assigning of statistical factors to reflect this
Sensivity Analysis	The concept of applying 'what-of' scenarios to important variables in the appraisal exercise
Investment Scope	The issue as to whether modern IT investments can be evaluated as discrete entities, given that most undergo continuous change and integrate with other applications
Timing	The impact on the timing of the investment (e.g. early might incur technological risk, late might mean loss of competitive advantage)

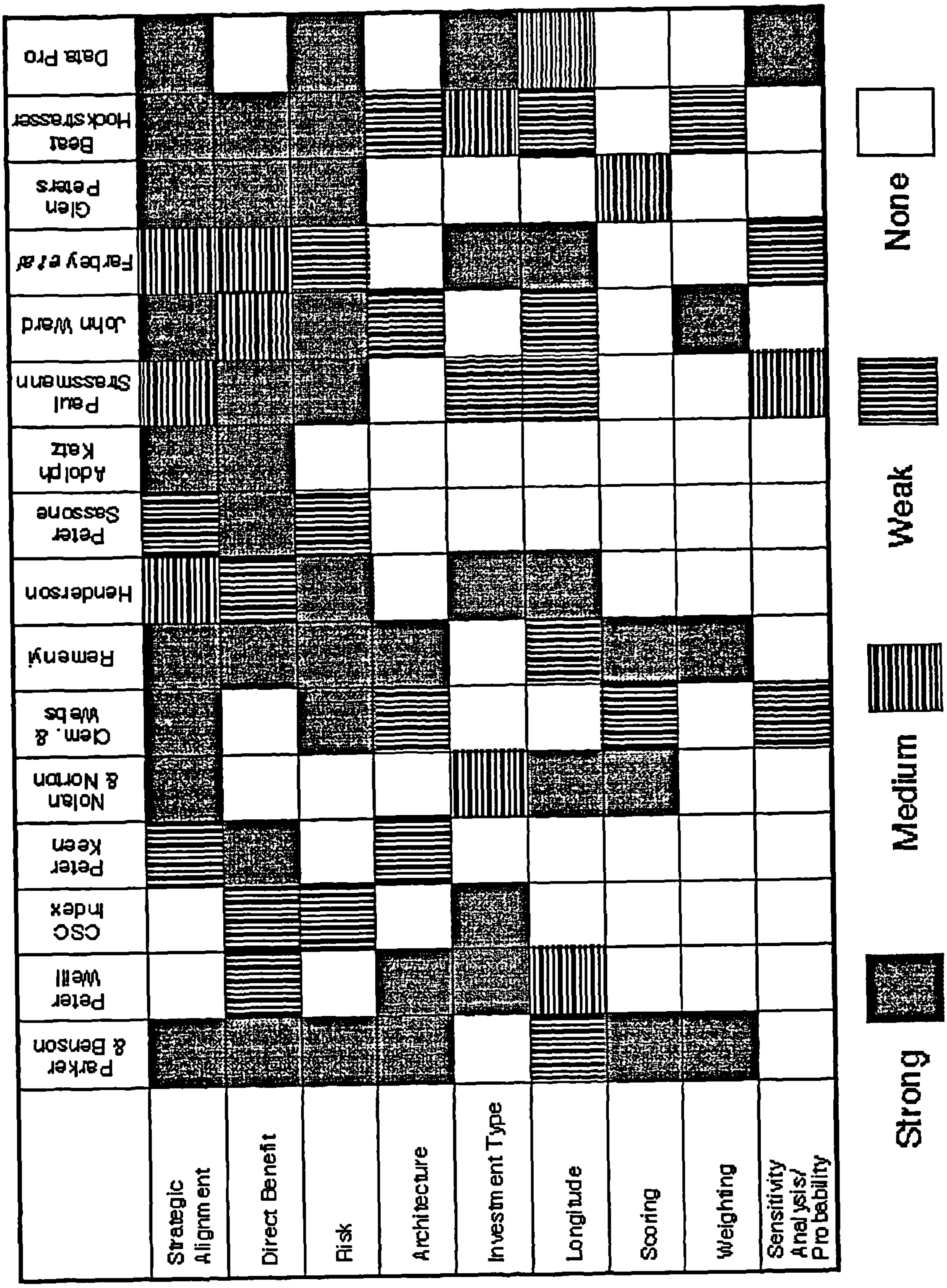


Fig. 5.6 Relevant Importance Assigned to Key Concepts

Summary

A consolidation of the main principles emerging from the foregoing review is outlined on Fig. 5.5., and their implications for the proposed framework are reviewed in detail in the following six chapters. As referred to in the "Overview of Research Methodology" (Chapter 2.1.1), the number of approaches to the issue of investment appraisal and pay-off is extensive, as is the variety of solutions proposed. Nonetheless, as Fig 6.1 shows, certain criteria predominate. One remarkable conclusion from the foregoing review is to the effect that few comprehensive methodologies are proposed. Many researchers address particular aspects of the investment appraisal process, or particular forms of investment (e.g., strategic or infrastructure), but apart from Information Economics, ISIS, and the framework proposed by Remenyi *et al,* there are few really comprehensive guides taking management through the whole appraisal process on a step-by-step basis. The primary value of the literature research has been the comprehensive coverage of the issues affecting the process, and the identification of the merits and demerits of the various options.

One significant factor has been omitted from all approaches however. That is business reengineering, or process redesign. While a relatively new concept, its impact on business organisation, and in particular its strong dependence on IT, underline its relevance to the evaluation process. This is discussed further in the next chapter, and in detail in chapter 9, but the framework deriving from this research differs substantially from all others in formally incorporated process redesign as part of the evaluation process.

Chapter 6: Strategic Alignment

6.1 *Introduction*

Strategic alignment has been described as "a state of harmony between the goals and activities of a business and the computer systems that support them" (115). This subject has attracted considerable attention in the literature, and continues to be "amongst the topics of foremost concern to executives involved with system issues" (116). The following two factors in combination are likely to have contributed to this level of attention.

(a) that the degree of strategic alignment is a major determinant of payback from IT investment (117).

A 1991 survey by Prenkummer and King shows that among 245 firms in a variety of industries in the US, ranging in size from $500 million to $5 billion annual revenue, those with strong business/IT alignment performed more effectively in five kinds of business contribution - return on investment, market share, internal efficiency, sales revenue, and customer satisfaction (118).

(b) very few organisations have succeeded in aligning their business and IT strategies.

A 1990 survey shows the following levels of business/IT linkages (119).

10% inextricably linked
32% somewhat linked
42% only tenuously linked
16% totally isolated

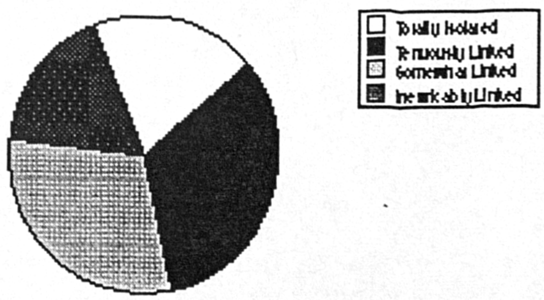


Fig. 6.1 IT and Business Linkages

And this lack of alignment can give rise to many problems. Ward *et al* cite the following negative impacts arising from a lack of alignment between IT and business strategy (120):

- systems and technology investments do not support the business objectives, leading to lost business opportunities and constraints on business development.
- duplication of effort, inaccuracy, delay, and inadequate information for managing the business.
- IT priorities are not based on business needs.
- incompatible IT options are selected, and time and money are wasted in retrospective attempts at integration.
- lack of understanding and agreed directions between users, senior management and IS/IT specialists leads to conflict and misuse of resources.

A leading US consultant has stated that "in my experience over fifteen years dealing with customers, my reading on the matter, and in the opinion of leading scholars on strategic planning, the major problem confronting business today is the lack of both a strategic planning process, and the lack of an integrated plan which should include the IS function as its nerve centre" (121). This suggests that strategic alignment forms a central element in the IT investment appraisal process.

6.2 Has Strategic Alignment a future?

A process of identifying management and business objectives along the lines described is essential, as it is bordering on the self-evident that if firms do not have their own business strategies defined, IT strategic alignment must be an impossibility. But the volatility of today's business environment, and the speed and unpredictable nature of technological change, make strategic planning for both business and IT a hazardous exercise. In attempting to link the two, the laws of complexity come into force, making the task exponentially more difficult. Some commentators argue that the task is impossible. Akram Yosri, a consultant and lecturer at New York University, argues as follows: "Rapid changes in information technologies, particularly software, coupled with economic constraints and fierce market competition are making ... long-range planning obsolete. Current conditions are just too volatile for anyone to predict technology needs beyond the short term" (122).

Certainly, fundamental changes with unpredictable outcomes are underway today. Four such "paradigm shifts" have been identified by Tapscott and Caston (123).

(i) The change in the world economic and political order. "No one is really sure what that change is or where it is going... The world is opening up and is volatile".

(ii) "A related shift is occurring in the business environment and marketplace... Markets and national economics are being transformed. Old rules are disappearing, as are walls to competition".

(iii) The change in the nature of organisations. Survival in the new environment calls for the new organisation to be dynamic and flexible. The structure will be flat and team-oriented, rather than hierarchical. "It is based on commitment rather than control. Business processes are streamlined for productivity and quality".

(iv) Technology will be the key enabler of the new business paradigm, and technological changes parallel the other shifts, becoming open, dynamic and flexible. "It works like people do, integrating data, text, voice.. and provides a backbone for team-oriented business structures. It blurs walls between enterprises, enabling the recasting of external relationships".

These shifts are already taking place. Marchand and Horton cite Citicorp's recent experience as an example of turbulence: "In a turbulent economy, the identity of a company may change over time and in turn alter the priority given to its mix of resources. For example, over the last ten years, Citicorp has shifted its corporate identity from a bank to a financial services firm, and finally to an information company that provides diverse financial information and investment services" (124). Galoob Toys has grown to be a $60 million company with just 115 employees. This is accomplished by having the manufacturing undertaken by contractors, who in turn directly supply the customers via independent distribution companies (125). Accounts receivable processing is handled by a factoring company. This radical approach, and Citicorp's transformation were both facilitated by, and heavily dependent on, information technology, particularly networks.

The experience of the Irish Electricity Supply Board (ESB) provides an example of a different impact from turbulence - in this case EU competition laws. The IT Training Department, which provided in-house training in IT issues to ESB staff, were given notice in early 1994 that it would have to become self-financing within two years. As one of their senior staff put it "we had some idea that moves along these lines might be forthcoming, but never this!". In a short time the unit will have to compete with external training companies for ESB business - while carrying a heavy overhead stemming in no small part from investments in legacy systems.

While acknowledging the significance of these changes, they should not invalidate the concepts of strategic planning and alignment, only the rigid process that took place every few years, and which became associated with these concepts. Citing the results of a major survey into strategic planning practice in the United States, Wilson cites as his "most provocative conclusion" that organisational and cultural issues have become "critical ingredients" of the strategic planning process in a way inconceivable using in traditional methods. He also cites the need to depart from the practice of using a single methodology for the planning process, with a multi-faceted approach providing the capacity to tolerate and adapt to the turbulence and unpredictability of today's business environment (126).

6.3 The Strategic Environment

A large number of frameworks for evaluating the strategic environment is available (127). The work of Ward *et al* (which in turn drew on structures developed by John Constable of the Cranfield School of Management) provides a suitable foundation for placing the strategic environment in the context of IT investment (128).

7.3.1 The External Business Environment

The Economy

Few businesses are immune to the effects of national and world economic trends. Wriston shows how economic growth, interest rates, the shift in economic power to the Pacific rim, developments in free trade/protectionism, and the globalisation of trade all affect decisions on the location, scope and technologies of IT investments (129).

Society

Societal changes such as demographic trends may need to be addressed in the context of a business plan. One such trend discernible in the more advanced economies is ageing of the population (130). This reduces the economically active proportion of the population, imposes demands on pensions and health care facilities, as well as introducing major changes in buying patterns.

Politics

Political events can have a significant impact on business plans. The changes unleashed by the fall of Communism in Eastern Europe and the former Soviet Union provide both opportunities and threats for many businesses, as do such events as the move towards greater cohesion among trading partners in Europe and North America, and shifts in the balance of power between right-wing and left-wing governments (131).

Law

Legal changes can not only impact individual companies, but can change whole industries, as occurred with this Act. There continues to be a strong growth in environmental legislation, which has potentially major repercussions for such industries as chemicals and power utilities.

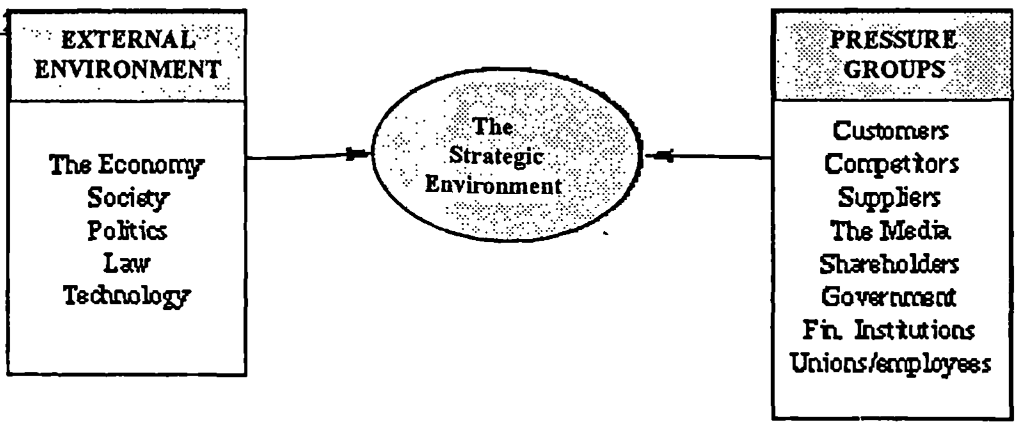
Technology

In no other sphere has the rate of change been so rapid as that in technology, particularly information technology. (See Chapter 3) The face of computing has been transformed over the last ten years, as distributed desktop computing has moved much control from the computer room to the end user. Of more significance is the capacity for IT to provide the possibility of significant competitive advantage, and to redesign business processes. (See Chapters 6 and 8).

Summary

The potential impact on business plans arising from the external environment calls for it to be monitored closely and regularly. This underlines the need for managers to have access to reliable, up-to-date information, with appropriate filtering, presentation, and decision support capabilities.

Fig. 6.1



Pressure Groups

Customers

In today's business environment, customers represent the paramount pressure group (132). Today, the customer is king. This derives from such developments as deregulation, which has opened up a new world of prices and choice, globalisation, which introduces new sources of supply, often accompanied by more attractive pricing and quality, while productivity improvements deriving from technological advances have led to oversupply in many markets. Many analysts believe that the process of defining business objectives should begin and end with the customer (133).

Competitors, Suppliers

These also represent important pressure groups, each interacting in its own way. The variety of potential pressure points is virtually limitless, and would depend very much on a company's strategic position in the market. For example, General Motors was big enough to force suppliers to adhere or change to certain computing and EDI standards (134). Looked at from the perspective of a GM supplier forced to fundamentally alter its IT architecture, this particular pressure would have major significance.

The Media

There has been an increase in the power, influence, and investigative capability of the media in recent years, particularly in the case of financial journalists. Company performance is being subjected to increasingly rigorous scrutiny, a scrutiny which can translate into direct impact at the Annual Meeting. The media is also taking, almost certainly with good reason, an increasing interest in irregular financial activities and breaches of environmental and health regulations (135).

Shareholders

Shareholders, particularly those in large public companies, have seldom exerted much influence in operational or even strategic issues, but this would appear to be changing as well. Particularly noticeable here is the practice of large institutional shareholders, such as pension funds and insurance companies to look for credible strategic business plans before investing. It too early yet to fully ascertain the impact of the rash of privatisations in recent years, which has significantly changed the profile of the typical investor (136).

Government

Government pressure may take the form of taxation initiatives, grants and subventions (sources of competitive advantage/disadvantage) health and environmental legislation, trade barriers and import/export regulations.

Financial Institutions

The capacity to lend - and call in - money affords financial institutions enormous pressure on businesses, as does the capacity to adjust interest rates and other lending conditions.

Unions and Employees

As organisations move from factory-based production to information-based services, and as unemployment levels continue to remain high, the power of unions has declined markedly, with union membership in the US being at an all time low (137). However, unions represent a legitimate interest, and still hold substantial power in many industries. The literature shows that most observers recommend the practice of involving staff and their representatives as far as is practicable in the formulation of business plans and when evaluating planned investments in IT.

Summary

This listing of pressure groups shows that, for the most part their capacity to exert pressure is increasing, and that this pressure can be significant. Many of these groups have an interest in the well-being of the relevant companies, or at a minimum, their involvement is not necessarily hostile. Ward *et al* are surely correct then in claiming that "in a competitive environment, the company that understands the needs of external pressure groups, and reacts to them, or exploits them most effectively, will succeed in the longer term" (138). Given the extent to which IT has now become part of all essential business processes, the extent to which these pressure groups are taken into consideration in evaluating potential investments in IT is likely to be important.

6.3.2 The Internal Business Environment

Current position of the organisation

The evaluation of the external environment needs to be followed by an evaluation of the corporate or organisational position as it currently applies. One approach is to analyse in the context of its strengths, weaknesses, opportunities, and threats, the so-called SWOT analysis (sometimes referred to as TOWS analysis). A typical SWOT analysis would assess a firm in the light of:

- financial status, including debt/equity ratio, liquidity, borrowing capability
- condition of products and services in terms of quality, lifespan (are products or services becoming outdated?) and relevance to market
- quality, motivation, and experience of staff
- organisational structures (are these consistent with present day business requirements?)
- the relative strength of the firm's position in the marketplace
- the possibility of introducing new products, services, or business units
- the possibility of entering new markets (e.g. arising from international trading agreement)
- the risk of new competitive challenges (drive for increased market penetration, new products or services, access to home market via international trade agreement)

An alternative, or more accurately supplementary, approach may be to view this issue in terms of *corporate imperatives.* Vincent defines corporate imperatives as arising "from those few key areas of business activity in which positive results are essential to the success of the enterprise. They come, consciously or unconsciously, from the corporation's organising principle, driving force, environment, and market. They are based on the corporation's products, services, goals and objectives, and on management's assumptions" (139).

Management Objectives

With a realistic set of business objectives now to hand, the next step in the process of IT investment calls for a mechanism for decomposing them into lower level, more clearly defined objectives, and thereby focus on potential IT investments.

While many approaches and methodologies are available, one of the most widely used is the Critical Success Factor (CSF) approach of John Rockart. Rockart defines critical success factors as "the limited number of areas in which results, if they are satisfactory, will ensure successful performance for the organisation. Critical success factors are the few key areas where things must go right, for the business to flourish. If results in these areas are not adequate, the organisation's efforts for the period will be less than desired" (140). It can be seen that this definition closely resembles that of corporate imperatives quoted above.

As described earlier, a key component of this research is the need to develop an approach to investment appraisal which will be applicable in an everyday business environment. This in turn demands that, to the maximum practicable extent, undue complexities are avoided. A derivative of the CSF/corporate imperatives approach is therefore proposed, as it is straightforward, adaptable, and, importantly, can be applied at various levels of the organisation. This latter capability assists greatly in the crucial task of linking business objectives with IT opportunities in a consistent manner throughout the organisation. This is a core requirement for aligning business and IT strategies (141).

A weakness in the formal CSF approach is that it does not account for the possibility of varying assumptions arising between managers of different departments or divisions. In the author's experience, a formal strategic plan does not necessarily negate this risk. Vincent puts it as follows: "executives from (different) functional areas of the business focus on their critical areas, each assuming that the balance of senior management understands. As a result, when these executives meet and converse, they are making assumptions about the knowledge and understanding of the various critical elements of each functional area. In fact the assumed knowledge and understanding seldom exists" (142).

6.4 Aligning IT and business strategies

The processes such as those detailed in 2 above in their relevance to today's business and technological environment resemble in many ways the relevance of the financial accounting measures (IRR, NPV and cost/benefit analyses) described in Chapter 4. It was seen that these measures, which originated in more stable and less complex times, still had a role in the investment process - albeit a much reduced one. It was also shown that reliance on these methods alone, under the misapprehension that they represented a comprehensive framework, could give rise to damaging consequences. In the same way, conventional business planning and alignment strategies require more sophisticated approaches which reflect the realities of the 1990s.

Some of the key issues are:

Architecture

As discussed in Chapter 9, the architecture is described as "a company's computers, software, databases, telecommunications, programming languages and operating systems and the relevant standards for each of these entities". The architecture to a large extent defines what a company can achieve, not only in IT, but also in business terms. Clearly then, providing an appropriate architecture must be seen as an essential enabler of strategic alignment. Component issues needing to be addresses are those related to outsourcing, centralisation versus decentralisation, the ramifications of open systems and possibly the migration from legacy applications. These are reviewed in more detail in Chapter 9.

Repositioning the systems activity

Aligning IT in the Phase IV environment (see Chapter 3) requires new skill sets from systems staff and possibly a repositioning of the systems activity. One research report states that "systems specialists responsible for systems definition should be part of the management team in the business units", while Earl describes it as a "embracing the marketing concept rather than adopting a production mentality" and sees it as a major challenge for most organisations (143).

Anticipating Technological Change

When one considers the extent to which technology forecasts have traditionally been wide of the mark, and the increasing rate of development, anticipating technological change may seem a hazardous exercise. It would appear to be an essential one however. Ward *et al* state that "it is precisely because the technology is changing so quickly that organisations need some form of strategy rather than react to every change in technology" (144).

Security, privacy and disaster recovery

This in many respects is the Cinderalla issue of many organisations, but it is assuming increasing importance, principally due to the closer electronic integration between companies, and their ever-increasing dependence on IT (145). Management will increasingly be called upon to define balances between providing adequate cover on these issues, and minimising the extent to which such measures impede normal business operations.

Senior management sponsorship and involvement

There is universal acceptance in the literature that the active involvement and support of senior management is essential for successfully aligning business and IT strategies, but as seen earlier, such involvement is by no means guaranteed. This is in many ways the corollary of the need to reposition the systems activity, and may prove as difficult. Their role according to Hickey, is "to set overall policy, objectives, priorities, and - most importantly - have to decide on allocation of scarce resources" (146). Senior IS managers recognise the strategic significance of this requirement. In a survey of the top 20 strategic IT issues undertaken by the Society for Information Management, "educate senior management" came second, superseded only by the need to "reshape business processes" (147).

Summary

As IT takes on a role of ever increasing importance in today's business environment, so the need to align IT with the business assumes grows more urgent. The rapid rate of change in both environments poses many difficulties in achieving this however, and demands profound change in the way such issues have been traditionally approached. Notwithstanding these difficulties, the linkage between effective deployment of IT and IT's alignment with the business (strategic alignment), demands that this objective be placed high on the corporate agenda. As with all profound change, it carries risks. Defining business objectives in the traditional ways, as outlined earlier in this chapter, are no longer adequate in themselves, representing merely a first step in the process. As Keen puts it "Instead of focusing on organisational structure, business today needs to look at the mechanisms that make communication simple, flexible, and natural. IT makes practical many of the visions of management thinkers" (148). This linkage makes strategic alignment an essential *perspective* for IT investment appraisal.

Chapter 7. Payback

7.1. Introduction

Payback differs from other *perspectives* in that it seeks to identify ***direct benefits*** from proposed investments, that is, the value of the anticipated benefits less the value of the anticipated costs. As will be shown, other perspectives have a vital bearing on the investment process - for instance an investment might provide immediate payback in terms of cost savings, but may be based on an architecture which has no future in technological terms, or which does not integrate with existing systems. In such an event, the *architectural perspective* indicates that the investment may not be worthwhile, despite the capacity for payback. Despite this, payback continues to dominate other factors in terms of investment appraisal (149).

The pervasiveness of information technology provides many opportunities for payback. As Porter and Millar put it, IT "is permeating the value chain at every point, transforming the way value activities are performed and the nature of linkages between them. It also is affecting competitive scope and reshaping the way products meet buyer needs" (150). The payback perspective will therefore examine the nature of the elements that are seen to contribute towards payback, and categorises the elements of value added. Given the trend away from so-called "hard" benefits towards those of the more intangible variety (see below), this chapter seeks to establish firmer criteria for evaluating the latter. An innovative interviewing technique, developed during the course of the research, is proposed, with particular emphasis on the delivery of benefits for the management process (see Appendix III). Finally, techniques for measuring and quantifying benefits, both as pre and post-implementation activities, are critically reviewed.

7.2 Types of Benefits

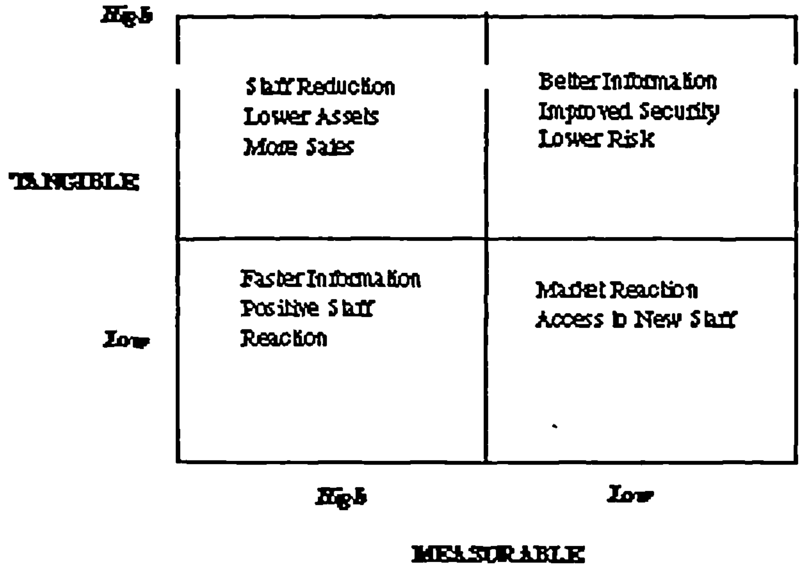
7.2.1 Classifications

A remarkable feature of the research into the issue of payback and benefits is the extent of the dogmatism on the issue by so many contributors to the field. Meyer and Boone, for instance, state that "there are two very different types of benefits resulting from information systems: cost displacement and value added" (151). However, Parker and Benson claim "there are three types of benefits: (1) tangible benefits; (2) quasi-tangible benefits, focusing most often on improving the efficiency of the already existing organisation; and (3) intangible benefits, focused most often on improving the effectiveness of the organisation" (152). Remenyi *et al* suggest two categories, tangible and intangible, while Strassman and others provide still other forms of categorisations (153).

Tangible benefits are defined by Remenyi *et al* as "those which directly affect the firm's profitability, while an intangible benefit is described as "one which can be seen to have a positive effect on the firm's business, but does not necessarily directly influence the firm's profitably" (154). Most commentators equate a direct or tangible benefit with the capacity to be quantifiable, but Remenyi *et al* argue that either form of benefit can be quantifiable or unquantifiable. A quantifiable tangible benefit is one which "directly affects the firm's profitability and ... may be objectively measured". Direct cost savings or revenue generation are cited as typical of this category. An unquantifiable tangible may be one which improves management information or the security of the firm, but which cannot be directly measured.

Remenyi *et al* go on to describe a quantifiable intangible benefit as one which can be measured, but whose impact does not necessarily affect the firm's profitability. Examples provided for this category are obtaining information faster, or providing better customer service. Finally, an unquantifiable intangible benefit is one that cannot be measured and whose impact does not directly affect a firm's profitability. Remenyi's IT Benefit Matrix is shown on Fig. 7.1.

Fig. 7.1 **Categories of Benefit**



All benefits however can be accommodated into the dual categorisation of direct (or tangible) and indirect (or intangible).

7.2.2 Tangible (Direct) Benefits

In the early days of computing, investments were made almost exclusively on the basis of tangible benefits, and these almost invariably related to cost savings of some form or other (155). The opportunities for such savings have now been greatly reduced (see Chapter 3). Nonetheless, opportunities do exist, and senior management continues to look to this area for justification of IT investments. Accordingly it still merits attention in the appraisal process.

The following represent the more common forms of direct benefits:

Cost Savings

Cost savings apply where the proposed system reduces or eliminates costs to a degree exceeding the investment and operational costs. These are the most simple and direct form of tangible benefit. Strassman divides cost savings into cost Reduction and Cost displacement (156). The former is described as "a short cut to increasing operating productivity" and cites the example of eliminating duplicate data entry in an order processing system as a direct means of lowering overhead expense. Cost displacement he describes as "the preferred method to simplify a business process through work-enlargement using computers", and cites the example of a sales order system which handles data entry, validation, and credit checking - activities previously undertaken by sales representatives. He makes the point that in determining the benefits from such a project, care should be taken to ensure that the result is not simply a transfer of work from one department to another, and that the time saved is applied in a way that benefits the company.

Strassman states that it is more difficult to evaluate cost avoidance potential, as "someone will always question why there are excess costs to begin with". He argues that for cost avoidance to make business sense, other possible alternatives should be investigated, or better again, the underlying validity of the activity should be justified. To illustrate this he questions the justification of video-conferencing as a cost avoidance measure for travel, asking whether the real issue should be the need for so many meetings in the first place.

Staff displacement

The most common form of cost saving traditionally related to staff displacement. The author recollects that in the 1970s and 1980s "headcount reduction" was almost like a mantra (see Chapter 3). Staff displacement normally occurs when routine clerical or administrative tasks, such as order processing or inventory control, are computerised, with related staff losing their jobs or being reassigned. Sometimes the savings may relate to overtime and/or travel avoidance. Savings can also occur without staff displacement or reassignment when a system allows increased volumes, or greater complexity, to be handled by the same number of staff.

Today, staff displacement no longer applies exclusively to those engaged in routine administrative tasks. Expert systems and artificial intelligence (while admittedly falling far short of the hype which accompanied their introduction) have resulted in computers taking over many of the functions previously undertaken by skilled employees. A good example here would be the typesetting function for newspapers, while executive information systems, by providing senior managers with direct access to their information requirements, obviate the need for staff associated with retrieval, filtering and presentation of information (157).

Quality Control

Systems which facilitate improved quality control can and should give rise to direct cost savings. These can take tangible form by way of reduced reworking, fewer rejections at final inspection, fewer customer returns, and reduced help-desk requirements.

Reduced computer costs

The general improvement in the price/performance ratio of computers usually means reduced capital and maintenance costs for new equipment, In addition, software maintenance costs generally increase in line with the age of the system (158).

Other Cost Savings

IT provides almost unlimited scope to make savings throughout the value chain. Inventory control systems can lead to savings on cashflow, floor space and employee time. Similar savings can be made by way of production control systems, while financial control systems can generate savings on cashflow and reduce misapplication of company resources.

Revenue Creation

New product introduction
Some systems (particularly in the financial services) enable totally new products to be introduced, or provide economic justification for hitherto unacceptable products, such as those identified by Chorafas in the financial services sector (159). While there may be an intangible element associated with overheads and launch costs, such investments can be classified as direct revenue earners.

Increased sales revenue
The promise of increased sales appears to be a common justification for IT investments. Whereas such benefits would normally be classified as intangible, the promise can be categorised as *tangible* when, for example, the unit cost of a product can be reduced, providing additional net revenue for an unchanged level of sales.

7.2.3 Intangible (Indirect) Benefits

As the role of IT changes, benefits of the intangible variety have come to predominate (see Chapter 3) The scope is almost limitless, but establishing the value from a business perspective is more difficult. Willcocks argues that this results in such benefits being "regularly omitted from feasibility proposals and subsequent monitoring, often on the grounds that they cannot be financially quantified, (and) are not cost justifiable" (160). As Hares and Royle put it "the ... valuation of intangible costs and benefits has always been the major area of difficulty for the subject of Investment Appraisal" (161). This characteristic represents for the authors the difference between the intangible and the tangible benefit.

The range of potential intangible benefits is wide, with commentators identifying improved customer service, higher job satisfaction, higher product quality, improved communications, gaining competitive advantage, avoiding competitive disadvantage improved supplier relationships, exploitation of business opportunities, and faster and/or more focused product development as among the most common (162).

Management Support

Many commentators see support for the management process as the key opportunity area for achieving benefits in today's conditions. Strassman has developed a comprehensive theory (Return on Management, or ROM) which is based on the premise that "management is the essential input to productivity. If a company is profitable, this is because of *management* (author's italics) not capital". He goes on to state that identifying "*Management productivity* (author's italics) would open the way to exploring the benefits of computers used by their principal customers, the managers of information" (163). Strassman differentiates the benefit potential of management and operations activities in the table 7.1:

Fig. 7.1 Differentiation of Management and Operations Benefits

OPERATIONS	MANAGEMENT
How to do	How to organise
Doing things right	Doing the right things
Today's business	Tomorrow's business
Structured tasks	Unstructured tasks
Today's decision for today	Today's decisions for future
Workflow shapes decisions	Decisions shape workflow

Parker and Benson see what they term Management Information Support as a key element in providing payback, even though they class it as "the leading example of hard-to-quantify information systems benefits" (164). They identify three categories of such support:

Traditional management support, which they see as benefits arising from management use of information which are capable of being evaluated in traditional cost benefit terms. They cite as examples cost reductions, enhanced quality control, budgeting and consideration of alternative uses and deployment of resources.

Strategic management monitoring: benefits in this category arise when IT can enhance management's capacity to approach competition and establish a company's posture in its business environment. For example "if a company intends to be aggressive and seeks to dominate its markets, then management information directed at how the firm is actually doing and how competition is doing, may be most useful".

Strategy and the management of performance: has as its basis the contention that IT "can make a difference in the execution of strategy, by making management better and smarter in pursuing strategy". This in turn is based on the logic that (1) everyone has computing, (2) with otherwise similar resources, some do better than others, (3) the difference appears to be management "hustle", which arises "only when an information system is available to report profitability and performance in the important areas".

Remenyi *et al.* see improvements in decision making and management productivity as important intangible benefits deriving from IT investments (165). On the basis that a decision will only be as good as the information on which it is based, the authors see "a system which delivers information which is more up-to-date, more encompassing and... which is processed into a useful format will help a decision maker to make better decisions". The issue of management productivity is discussed below, and while the authors acknowledge that such productivity is difficult to assess in the case of management, they provide a good example of how improved management support facilities translated into business value for a motor firm.

Competitive positioning

Sales support systems : Systems which increase the possibility of additional sales can take many forms. The capacity to target the most promising customers greatly increases the chances for sales staff to clinch additional sales. Interactive multimedia enables potential buyers to gain a lifelike appreciation of products while providing information on prices, specifications and delivery dates. This enables sales staff to concentrate on the most promising customers, while minimising the time spent on technical and logistical issues. Kaye has provided a range of case studies which show how marketing positioning can be improved by the use of such techniques (166).

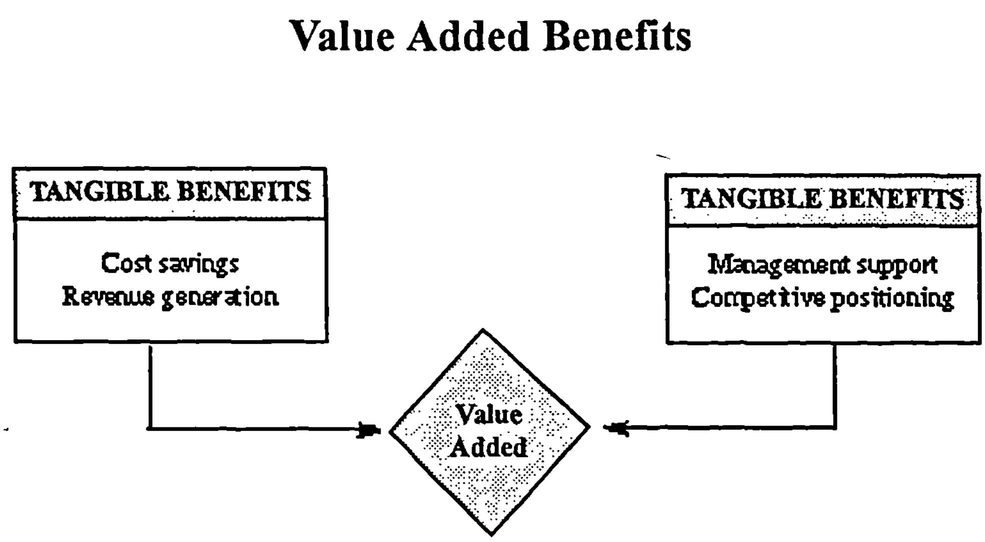
Customer lock-in

Some of the most successful IT initiatives have derived from their capacity to lock a firm's customers in, or otherwise predispose customers to purchase from the firm. A case study frequently cited is that of the McKesson pharmaceutical distributor. A rudimentary (by today's standards) order processing system transformed what had been a company in decline (167). The system as introduced in 1976, whereby data collection devices, powered by car batteries, were wheeled around customers' stores, dramatically cut order processing costs and timings, and was refined further to enable the orders to be unpacked in a way which reflected the customers' shelf locations. Supplemented by a range of further enhancements, the system effectively locked the customers into large-scale purchases from the McKesson organisation.

Further Examples of Intangible Benefits

There are almost limitless possibilities for intangible benefits based on IT investments over and above those already discussed. Hares and Royle cite a higher price for a premium product or service, more sales from an existing customer, retained custom, additional sales arising from better marketing decisions or product presentation. Moriarty and Swartz provide a wide range of benefits deriving from the application of IT to the Marketing function (168), while Boynton and Zmud have compiled a comprehensive series of case histories identifying benefits across a broad spectrum of industry groupings (169).
A summary of tangible and intangible benefits, leading to value added, is shown on Fig. 7.2

Fig. 7.2 **Benefits Summary**



7.3 A review of current approaches

Whilst a detailed evaluation of benefits measurement techniques is outside the scope of this research, it is appropriate in the context of this chapter to identify the potential and limitations of some of the existing approaches.

Cost benefit analysis (CBA)

Even though CBA is not a new approach, it is still widely used, despite an acceptance of its limitations. Research by Earl, Coleman and Jamieson, Farbey and others identifies the predominant characteristic of the CBA approach as an emphasis on monetary terms as the basis for evaluation, usually enhanced by the application of discounting techniques (see also Chapter 4), (170). The more important of these (which are closely related to the issues of 'efficiency versus effectiveness' as discussed in 4.3), are detailed below, and suggest that not only is this technique of limited value in benefits measurement, it can, in certain circumstances, be counter-productive.

The CBA approach is:

Crude: "Before and after" measures of benefit are crude in that they will be accurate only if work patterns remain unaltered after the implementation of the system. Apart from instances where faster hardware is installed to run an existing computer-based system, this is unlikely to apply, work patterns almost always change, usually by the elimination of the more routine tasks (171).

Misleading: The introduction of a new computer system involves additional expense in terms of software and software maintenance, and possibly hardware and other costs. Except where these can be directly assigned to a specific user department, they must be absorbed as overhead. Frequently this overhead will not be taken into consideration in measuring the benefits, and even when it is, the allocation will be the subject of a certain amount of arbitrariness (172). For example, if there is spare processing capacity, will the new system be allocated a proportion of processor costs - should it? In the absence of a consistent approach to these issues, misleading interpretations may result.

Inadequate: Such measures are inadequate for certain types of work, particularly those in the service sector which is forming an increasingly large proportion of economic output (see Chapter 1). For example, in professional services, with computerised assistance, an accountant may be able to produce more sets of accounts, or a lawyer more opinions, in a given time. This would be seen as increased productivity. Yet, depending on the amount of work on hand, this could actually result in a net reduction in charged time, and therefore earnings for the practice. Citing an assignment he had worked on, Strassman showed that, depending on how one approached the issue, productivity gains could be plus 6.9%, minus 0.7%, or plus 77% (173).

Cannot accommodate the growth of overheads: Direct material and labour, which previously represented an overwhelming proportion of the cost of production, have now been overtaken by overhead costs. In discussing this point, Wriston cites the example of the microchip, for which material and direct labour now comprise only 11% of manufacturing costs - and this percentage is set to fall. This trend renders the unit cost, efficiency approach increasingly less appropriate measure of business value (174).

Leads to incomprehensible complexity: Strassman has used the phrase "micromyopia" to represent what he saw as the tendency to break a problem down into increasingly smaller components when it could not at first be understood (175). This theory rests on the illusion that all office tasks can be broken down into minute, controllable elements. If this is accepted, all tasks can be evaluated individually, timed and controlled, and therefore measured in terms of productivity. This complexity undermines senior management's understanding, and opens the way for manipulation by the cognoscenti. Although this danger is now receding as a better understanding of the dynamics of office productivity begins to take hold, the idea that deeper analysis leads to deeper understanding still has adherents (176).

Despite these limitations, CBA continues to be "a common element" in most investment appraisal exercises (177). While recognising these limitations, Norton concludes that CBA continues to be used because it is easily understood, and uses a methodology and language with which finance staff are comfortable (178).

7.4 Other approaches used:

Make End-users Responsible

This approach to measurement is espoused by Keen and Mathieson (179). The principle cited is that in the light of the movement from centralised data processing to end-user focused applications, it makes sense for the end-users to define and be responsible for the benefits. Keen puts this in the context of the IT planners being held accountable for the cost of supplying the systems, but end users should be responsible for the benefits. He cites the example of a bank which made a major investment in ATM machines. These, and the related software, were implemented on time and within budget, but failed to demonstrate satisfactory returns. While he sees this as partly due to the inadequacies of conventional accounting techniques (see Chapter 4) the primary reason was the failure of user management to implement the relevant cost-cutting measures enabled by way

of the new system.
The concept of end-users defining and being responsible for benefits is central to this thesis. Nonetheless, it is practical only for realising the more tangible forms of benefit, and could be misleading and counter-productive for proposals relating to the reengineering and architecture *perspectives.* If this approach becomes the standard measurement criterion, such investments will be evaluated from a narrow, short-term perspective. A possible compromise is suggested whereby end-users agree, and be assigned responsibility for, specific benefits anticipated from a proposed project. This would enable the proposal to be evaluated in its entirety, yet assign metrics responsibility for those elements controllable at end-user level.

Introduce Anchor-Measures

An anchor measure is defined by Keen as "an operational indicator of performance that can be used over time to identify .. IT impact". Such measures are based on the overall objectives of the firm, as defined by what managers deem to be important This approach is also proposed by Gold, who cites as examples customer relations, transaction cycle time and employee morale (180). Underlining the importance of management intent, Keen makes the case that a management team with cost reductions as a priority would use annual cost of servicing a customer or processing a transaction as a suitable anchor measure, whereas if market share were the priority, an appropriate anchor measure for the effectiveness of the investment could be revenue per customer.

Anchor measures are a useful addition to the measurement process in that they offer an alternative to traditional accounting-based criteria, which have been shown to be inadequate. Furthermore, if closely linked to management's Critical Success Factors, they will evaluate benefits in terms of what management perceives as the key issues. It would appear important however that anchor-measures be balanced. For example, a measure based on transactions processed per employee must be balanced against the possibility of lower levels of customer support. In a consultancy assignment in the steel industry, the author saw that while an anchor measure - having essential stock always available - was achieved, the achievement came at the expense of gross overstocking and stock obsolescence.

Measure Return on Management

Return on Management (ROM) is a term patented by Paul Strassman and is based on the hypothesis that the benefits from IT in today's business environment derive from greater management effectiveness (181). He demonstrates convincingly that this task has not been achieved successfully to date (182). Citing a major US IT productivity study, he reveals that costs of management were omitted from all productivity calculations, yet these were the most expensive and fastest growing elements, and underlines the point that this trend will continue. He also shows that traditional financial control methods reflect their origins in the Industrial Era when capital and labour were the essential components of costs and productivity. He shows that this focus continues, despite the fact that annual costs of corporate bureaucracies were becoming more expensive than the annual carrying costs of capital. A process for measuring the effectiveness of management was therefore called for, a process he calls ROM.

The definition of ROM (Management Value Added divided by Management Costs) is deceptively simple. ROM calls for an elaborate data collection process which has the objective of separating out "management value added" and "management costs". Strassman provides an analytical framework for this, but measures can only be achieved by the painstaking accumulation and sifting of raw data, a task requiring all business transactions to be linked or tagged with the ROM classification criteria. The difficulties involved will vary widely between differing computerised accounting systems. Nonetheless, Strassman has over 100 companies operating this approach, and claims to have identified major benefits in terms of directing IT investments.

Perhaps because of the claims made on its behalf, ROM has attracted much comment. It is a fundamentally new concept. In focusing on management, both as a significant user of IT in its own right, and as a pivotal determinant of corporate performance, it addresses aspects which have heretofore been outside the span of formal evaluation methodologies. Its biggest drawback would appear to be the scale of the effort required to introduce - and maintain - the ROM process. Strassman counters this with the argument that an undertaking of such corporate importance cannot be expected to be easily accomplished, especially given the inadequacies of current cost accounting methods.

Another drawback appears to apply to the IT element of the measurement. The author has studied Strassman's work in depth, and spoken with him on the matter, yet finds considerable difficulty in isolating the IT content of the ROM performance statistics. Whereas this does not invalidate the overall ROM metric, it does limit its use in terms of IT evaluation. A potentially more serious drawback stems from the possibility that findings generated by this method may be inaccurate and/or misleading. Professor Tom Lodahl in conversation with the author stated that Strassman had "simply got his figures wrong", a result of the inadequacies of underlying accounting systems, and the difficulties of maintaining consistency in ROM categorisations (183).

Correlating I/S Effectiveness with Business Performance

Measuring the impact of I/S on business performance could almost be classed as the "Grand Unification Theory", so far-reaching and seemingly intractable are its ramifications. Professor Tom Lodahl and Kay Reddit, operating through the CogniTech Services Corporation claim to have made a fundamental breakthrough in this area (184). CogniTech apply three measures of business performance, three measures of I/S effectiveness, and seek to establish a correlation.

The three measures of business performance are return on equity, earnings per share, and the revenue/expense ratio. The three measures of I/S effectiveness are I/S contribution to managerial goal achievement, the range of I/S coverage within the organisation, and a rating system by users on I/S effectiveness. The I/S effective assessment involved obtaining very large numbers of data points, for example, to measure the contribution to managerial goal achievement required 800 data points, 80 points from 10 managers. These data points measure managers' judgement on the extent of I/S contribution to their goals. These goals are in turn decomposed into four sub-categories, the actual I/S contribution, the potential contribution, I/S contribution relative to other factors, and the worth of I/S in relation to its cost.

Much of the research focused on establishing the determinants of I/S effectiveness, defined as contributing to corporate objectives. An early finding showed an I/S organisation optimising *efficiency* (i.e. seeking to maximise I/S productivity) could not maximise *effectiveness* as the two require fundamentally different operating and organisational cultures. The research collected no fewer that 1200 different variables, of which 79 were shown to have significant impact on I/S effectiveness. These were synthesised into a framework which can be applied (with some modification) to companies in general.

One of these measures, I/S contribution to managerial goal achievement, achieved a strong correlation with the business performance indicators. This at face value has major implications for the whole field of measurement. Yet some question marks exist. As Paul Strassman put it to the author the CogniTech approach applies statistical weightings, correlation, and standard deviation techniques to subjective opinions, and then sought to assign statistical validity to the resulting correlation with the "hard" business performance measures defined earlier (185). Whilst this may offend the purist, and may not be mathematically valid, it should not detract from the value of the overall thrust of the findings.

Another possible weakness relates to the judgement by managers as to the effectiveness of I/S contribution to the achievement of their goals. There must be a suspicion that managers in the less successful companies would be likely to attribute less value to the I/S contribution. After all, if the companies are not successful, the instinctive reaction will be to attribute blame or responsibility to others for this failure. If I/S plays a major supporting role in their activities it underlines even more clearly their responsibility for the firm's poor performance. The reverse applies for successful companies, with managers likely to be more magnanimous in their assessment of the contribution by I/S.

Overall however, the research by CogniTech appears to have added significantly to the current level of knowledge in this area. The scope and scale of their questioning provides a vast resource of research data, and as their techniques are more widely applied, further refinements should result.

Measuring End-user Satisfaction

The increasing difficulty in measuring the effectiveness of IT applications has resulted in a corresponding growth in the use of user-satisfaction techniques to address this issue. User satisfaction is considered by Remenyi and Money to be measurable by a comparison of user expectations (or needs) of the application with the perceived performance (or capability) on a number of different facets of the application (186). There are a number of instruments designed to measure this effectiveness, one of which has been developed by Remenyi and Money (187).

This approach is based on 24 attributes designed to first evaluate the expectations of the system, and then to establish the extent to which the expectations have been met by the application. Users first rank the attributes in order of importance (or expectation). The parameters are Irrelevant, Not Important, Important, and Critical. The same attributes are then subjected to a post-implementation evaluation of satisfaction, the parameters

being Very Poor, Poor, Good, Excellent.
Rank, mean, and standard deviations are calculated for expectations and actual performance, and mean perceptual gap scores, together with their standard deviations, are also calculated. The final calculation is a set of correlations between the gap scores and the satisfaction scores. The findings may be represented graphically by means of a snake diagram, which highlights the scale of the deviations. Further sophistication is added by utilising regression analysis to establish the key variables in determining the overall satisfaction scores.

While gap analysis models appear unlikely to offer an explanation of all the variables (the case study in question explained only about 40%), this should not take from the significance of their contribution. The Remenyi/Money model has added advantages in that it is cheap, quick, and does not require a lot of expertise to administer. This value is however contingent on the extent to which end-user bias can be reduced.

The Problem of End-user Bias
Of its nature, end-user satisfaction measurement techniques involve a substantial element of subjective judgement. This in turn opens the possibility of bias in these evaluations.

Mathieson identifies the following possibilities (188).

1. The application may be satisfactory from the users polled, but may be unsatisfactory for the organisation at large. This problem is minimised when all potential users partake in the evaluation.

2. Users may require functionality from the application which was not identified as part of the original requirements. This may give rise to a negative response, but is not fair or accurate within the terms of reference.

3. For those applications which automate a valued skill or set of skills, the end-user may be predisposed to present a negative assessment.

4. Where a supervisor may be known to have a particular attitude to an application, or to IT in general, those in a reporting position may echo this reaction.

5. Biased test data can have a significant impact. For example, in evaluating a spreadsheet, the structure, scope, and composition of the data can result in the test becoming anything from an enjoyable exercise to one which is difficult and frustrating. Clearly the reaction of the user will be influenced to some degree by this.

The author has identified the following additional bias factors during the course of various implementation and consultancy assignments.

1. Reaction by the user may be partly determined by the level of experience. For example an inexperienced user with few keyboard skills may become flustered, may find difficulty in learning the system, and may therefore adopt a negative attitude. Conversely, a user with low expectations may be unduly impressed by an system's performance. Bias is involved either way.

2. Career prospects may be enhanced or inhibited by the introduction of the system. This consideration invariably introduces an element of bias.

3. Some users have strong commitment to specific operating platforms, and may evaluate applications on this platform more highly than an application for a different one for this reason alone. A common example relates to that of the DOS operating system, with which users may be comfortable, having invested considerable time and training in requiring the requisite knowledge. A Windows application introduces a very different operating environment, and may result in an application receiving less favourable assessment than that on DOS, irrespective of functionality.

4. Moods of individuals can have a significant bearing on evaluations. The author has undertaken evaluation reviews with individual users when the mood was clearly negative, and repeated the process when the mood had improved. The evaluations demonstrated a commensurate improvement!

This wide range of findings suggests that such potential sources of bias must be identified and addressed as part of the user evaluation process.

7.5 Issues for the Investment Appraisal Process

Measuring the Benefits

Given the scale of IT spend, its pervasiveness throughout most organisations, and the lack of quantifiable payback (see Chapter 1), there would seem to be a strong requirement to measure the benefits from IT investments. The issue is neatly summarised by the *I/S Analyser*. "With the increased importance of information technology investments has come the louder call for quantifying the benefits of these investments. Few companies take 'before' and 'after' measurements, and even fewer relate information technology benefits to business performance. One reason for this situation has been a dearth of measurement frameworks" (189). The report could have mentioned other reasons as well (190). Due puts the figure for those companies which do not use any standard to measure the productivity of their investment as high as 95%, and cites (as does *I/S Analyser*) the lack of suitable performance metrics as the primary reason (191).

Due provides four reasons for this lack of metrics:

The first is the time lag between the development of a system and its organisational impact. The changes that occur over this period weaken attempts to relate development costs and eventual benefits. The second relates to the high proportion of intangible benefits associated with IT investment. These benefits do not lend themselves easily to measurement, and must be seen in the context of low overall productivity gains. The third relates to investment in systems for competitive advantage. These were not fully evaluated, either beforehand or afterwards, on the basis that they were competitive necessities. Due makes the point that this often resulted in highly inefficient applications. The fourth reason relates to the shift from manufacturing to service industries, with productivity in services being more difficult to measure.

Despite this, there appears to be a widespread belief that benefits need to be measured, and can be measured. "Measuring the effectiveness of IT" has consistently ranked as one of the top ten issues in all major surveys, and two-thirds of Fortune 100 companies' chief executive officers believe that their companies are not getting the most for their IT investment" (192).

Benchmarking

Benchmarking may be defined as the attempt to compare the performance of one's own organisation with that of another, with a view to identifying where and how improved performance could be achieved. It is becoming increasingly popular, and several organisations devoted exclusively to undertaking benchmarking studies have been formed (see below) (193). The research undertaken suggests that benchmarking normally takes place against acknowledged leaders in the field, against industrial averages, or within specially formed benchmarking groups.

The process does appear to have many attractions. Measuring one's performance against internally developed and focused criteria, while clearly better than no measurement, must be less comprehensive, and more subjective, than measuring against one's peers. It is also clear that, given the rapid rate of technological change, the breadth of an externally focused set of criteria is likely to provide much needed balance. Several potential drawbacks have been identified however.

Benchmarking Against The Best

Research in this area suggests that benchmarking against acknowledged high-performing companies is the most common practice. The objective is to compare one's processes against the best, identify the scale and nature of the differences, and implement a programme to narrow or bridge the gap. The theory is fine, but the practice may be a lot less so.

(a) The high-performing companies may not wish to benchmark against a lower performer. There is little to be gained by them. When companies gain a high recognition factor in this area (e.g. Xerox Corp.) they tend to be inundated with requests for benchmarking. It would be impossible to meet such demand.

(b) Companies seeking benchmarking frequently fail to analyse their own processes in the required depth. Links with other companies then degenerate into what has been described as "industrial tourism", of general interest, but not leading to concrete proposals.

(c) The impact on staff morale can be significant. Some companies undertake benchmarking under the understanding that failure to measure up could result in outsourcing

IT Effectiveness Surveys

These surveys purport to identify the "best" levels of expenditure on IT by collecting data from a large cross-section of companies. Among the criteria they use are:

- IS budget as a percentage of revenue

- Value of installed equipment as a percentage of revenue
- Percentage of the IS budget applied to staff
- Percentage of the IS budget applied to training
- Percentage of personal computers and terminals per employee

Based on these findings, attempts are made to identify the optimum levels under each category. From a benchmarking perspective, organisations can then identify where, and by how much, they deviate from either the optimum spends as prescribed by the magazines, and/or the averages identified. That is, even if the formulations used to evaluate the optimum spend under the various categories are not accepted, the reasoning is that it can be instructive to compare one's own performance against industrial averages. This line of thinking is flawed however, due to the difficulty, if not impossibility, if obtaining consistency in definitions and data. A brief review of the potential difficulties with the individual elements may be instructive:

IS budget: The basic elements of an organisation's IS budget are clear-cut. Infrastructure elements such as a network backbone, centralised data processing hardware and linked terminals, DP Consumables such as stationery, IS staff costs, and IS consultancy fees will almost always be included. Less clear-cut are items such as process control computers and point-of-sale terminals. Yet in some organisations the expenditure on this kind of equipment can be very significant.

The real problems with quantifying the IS budget however are associated with departmental or end-user computing. PCs, PC software, and training are just some of the items which may or may not be included in the IS budget. Some organisations include them others do not. Even within the same organisation, some departments will include some items as IS spend, others will not. A 1993 survey estimated that on average between 15% and 20% of companies' overall IS expenditure will not be incorporated in the IS budget. More significantly from the benchmarking perspective, it shows that such spending "varies greatly from company to company", and can sometimes go as high as 60% of the IS budget (194).

Value of installed equipment: This category is not as prone to variances (both between and within organisations) as those for the IS budget, in that it excludes elements such as training and consultancy. Nonetheless, as the review of the IS budget above shows, assessing the value of the hardware alone can be problematical.

Percentage of IS budget applied to staff/training: The difficulties of obtaining a consistent value for the IS budget of necessity undermine any ratios based on it. Such ratios are further undermined by potential variances related to staff and training costs. For example, in an end-user environment, a department may need to assign a large proportion of an employee's time to trouble shooting and support for users with lower levels of IT skills (195). This may or (more likely) may not be included as IS staff costs. The definition of training is very flexible. For example, seminars, conferences, and trade shows may or may not be included. The author has seen these being included in some instances, excluded in others, even within the same department in a company.

Percentage of personal computers and terminals per employee: This would clearly be the easiest category for which to obtain consistent and comprehensive numbers. Even here however, comparisons can be misleading. Some organisations by virtue of operational requirements will require a high proportion of IT users (banks, airlines), while others will only require a low proportion (a postal service).

The conclusion then would appear to be that benchmarking on the basis of these criteria is unlikely to be of value. In fact, given that the figures will almost certainly be inconsistent, it could be dangerous.

Summary

It is clear that payback, in the form of addressing the direct and indirect benefits from potential investments, is an essential evaluation perspective. In fact, for many years it was almost the only criterion for many organisations. With trends moving from manufacturing to services, the intangible benefits are increasingly predominating, resulting in the quantification of payback becoming more difficult. Several leading commentators have taken radically different approaches to evaluating benefits from IT, and while many make a valuable and relatively cost-effective contribution, others, such as Strassman's Return on Management, impose enormous demands on data gathering.

The practice of performing before and after measurement is seen as vitally important by IS and finance managers but is undertaken by few companies. Comparative inter-company studies and benchmarking have superficial appeal, but can generate misleading values and conclusions. In general summary, payback remains an essential element in the investment appraisal process, but quantifying it is becoming increasingly more problematical.

Chapter 8. Process Redesign

8.1 Introduction

Numerous researchers have commented on the duration in historical terms of today's business structures, which remains based on theories originally formulated over 200 years ago (196). The core principle of this theory is the division of labour, by which workers are assigned narrowly-defined, specific, tasks, ideally of a simplified nature. Although this theory has been modified and enhanced down the years, in its essentials it remains unchanged. Whereas it has brought many advantages in the form of clear-cut operational practices, and lends itself to effective operational control, it is singularly unsuited to meeting the requirements of the present-day business environment. Among the characteristics of this environment are short product development and life cycles, tougher competition, volatility, and a rapid increase in the incidence of mergers/demergers, acquisitions/divestitures (197).

Given this unsuitability, many firms have felt compelled to reassess their organisational structures in a fundamental way, that is, by redesign processes from the ground up, and abandoning all existing assumptions, in particular breaking with the conventional task-based methods characteristic of traditional hierarchical organisations (198). This new approach, which has been gaining force in recent years, is variously been known as business reengineering, business process redesign, and process reengineering. Whatever the appellation, (and Tapscott and Capston show that there are at least fifty methods and approaches to what is known as business reengineering (199)) all approaches operate under the same basic principle, namely, that speeding up the old way of doing business will no longer suffice. Venkatramenn, for instance, in contrasting the role of IT in the 1990s to that of earlier decades, states that the "dominant strategy theme for the 1990s will be the recognition and exploitation of IT capabilities for fundamental choices of business scope and .. organisational reconfiguration" (200). To put this in perspective, a review of the development of conventional organisational structures is proposed.

8.2 The Development of Conventional Organisational Structures.

8.2.1 Historical Development

The work practices and organisational structures which form the basis of most enterprises today are founded on principles first enunciated by Adam Smith in The Wealth of Nations, published in 1776 (201). These are based on Smith's studies of the workings of a pin factory. He found that the number of pins produced could be substantially increased were each worker, who had previously been involved in all the tasks associated with pin making, to concentrate on a single step of the manufacturing process. Whereas the claimed benefits appear to be extravagant (up to 5,000 pins per day applying division of labour, as against 20 using generalised practices), the book clearly shows that significant improvements in throughput could be achieved through assigning specialised tasks to individual workers. Thus was the principle of the division of labour born, and with it the paradigm for industrial organisation for the next two hundred years.

A major enhancements came by way of Henry Ford, who introduced the assembly line, which brought the work to the employee, in contrast to the prevailing arrangement whereby the employee moved to where the work needed to be performed. Ford also simplified the tasks to an unprecedented degree, many being as simple as tightening a nut or fitting a radiator cap. As the size of Ford's operation grew, major difficulties were encountered, and these led to the second major enhancement, which was introduced by Alfred Sloan, of General Motors (202).

Labouring under the same difficulties as Ford, Sloan applied division of labour techniques to management. He did this by splitting General Motors into autonomous divisions, based on models in the GM range, which effectively became companies in their own right. This was in effect applying the division of labour principle to management, and Sloan expanded it by having managers specialise in areas such as production, marketing and finance - a radical departure for the time.

8.2.2 Strengths of the Hierarchical Structure

Although now questioned by many commentators, the hierarchical structure brought advantages of the "command and control" variety.

(a) Everything was clearly defined. Job descriptions were closely tied to narrowly defined tasks (203). For example, up to the time the author left the Ford organisation in 1986 there was a Procedures Manual for every conceivable task in the organisation. This meant that every employee had clear guidelines under which to work, supervisors knew exactly what they had to supervise, and minimal time was spent in addressing how to perform required tasks - it was all "in the book".

(b) The simplicity of the tasks, and the availability of clear-cut procedures meant that training costs were minimised, while replacing and transferring staff incurred minimal disruption.

(c) Control was enhanced through a wide range of comparisons. The Ford system which applied roughly between the late forties and the late eighties would have been typical of an advanced multinational at this time. Sophisticated budgeting enabled detailed comparisons to be made over the whole business spectrum, month on month, year on year, unit labour cost comparisons, country by country comparisons - all were facilitated by the company's common operational and organisational structures. The rigid hierarchical structure also facilitated clear and incontestable modes of operational control (204).

(d) The operation was scaleable, and thus responsive, in meeting demand fluctuations. Given the low level of training required, and the clearly defined operating procedures, new workers (and this also applied to supervisors and management) could be introduced into the manufacturing process relatively easily.

8.2.3 Weaknesses of the Hierarchical Structure

As tasks became less complicated, their number of necessity grew. In attempting to capitalise on economies of scale, companies were also growing, and this added to the control complexity. This imposed huge demands in terms of controlling and knitting together these disparate tasks. "The growing number of people in the middle of the corporate organisation chart - the functional or middle managers - was one off the prices companies paid for the benefits of fragmenting their work into simple, repetitive steps and organising themselves hierarchically" (205).

This led to several serious disadvantages, which became particularly serious in the context of the changing business environment which evolved throughout the 1980s.

(a) Probably the biggest disadvantage associated with this structure is the bureaucratic apparatus required to administer the increasingly complex process involved in delivering product or service to the customer. The balance of costs moved from material and direct labour to overhead (206). It is clearly more difficult to ascertain the value added (if any) generated by overhead, and one of this system's key benefits (costing and control) began to dissipate.

(b) As suggested earlier, while the hierarchical structure was flexible in terms of volumes, in most other respects it was inflexible. Most tasks were governed by Operating Procedures, and those performing the tasks operated within a rigidly defined reporting structure. Changes, as the Ford model demonstrates, could only be introduced after a lengthy intra-departmental consultation process, and one department could undermine the new arrangements if dissatisfied (207).

(c) As companies grew in size it became increasingly difficult for individual departments to see the big picture - that is, the overall objectives of the organisation became obscured. In fact, some companies deliberately fomented a form of "creative tension" between departments. (See below)

(d) With layer upon layer of management in place, and with staff increasingly focused internally on meeting departmental goals, the ability to focus on customer requirements became weakened.

Many of the above weaknesses can be identified in an example from author's experience of the Dealer Audit activities as practised at Ford. Manufacturers' sales staff frequently ignored, or even assisted, dealers in making unauthorised claims on the manufacturer. It made their jobs easier in many ways when dealers were in receipt of such bonus payments, while the loss of money to the company did not affect them in any way. By way of contrast, Dealer Audit staff took a narrow and restrictive view of all claims, invariably rejecting those failing to meet "the letter of the law". The spirit of the "law" in such cases did not count. For instance, a claim for a repair undertaken when a car may have been only a couple of days out of warranty would be rejected in its entirety. Audit were only doing their job, which was to strictly apply the terms and conditions under which payments were made.

Such issues were often resolved only through high-level arbitration and negotiation internally at the manufacturer, and subsequently with high-level dealership staff as well. Frequently, the eventual settlement resulted in attempts by the dealer to recoup some or all of the eventual chargeback from the purchaser of the vehicle. The affect of all of this on relationships between manufacturer, dealer and customer can be imagined, as can the amount of time spent on investigating and resolving such cases. Yet, given the organisational structures in place (rigid hierarchies, strict departmental separation, with a consequent emphasis on tasks rather than processes) it is difficult to envisage a radically different approach which would meet the twin requirements of financial control and customer satisfaction.

8.3 Characteristics of Today's Business Environment

It is now appropriate to assess the degree of suitability of traditional organisational structures in the context of today's business environment by identifying the characteristics of this environment.

Primary characteristics:

(a) Increased competition

New "mean and lean" start-up companies, unencumbered by outmoded cultural and organisational structures, are dominating, and sometimes creating, markets as traditional companies struggle to adapt. In less than a decade, IBM has seen its dominance of the computer industry disappear, while Microsoft has emerged from being a bit-player to becoming the dominant player in the software industry (208). In retailing, the decline of Sears has been paralleled by the growth of WalMart (209).

(b) Mergers and acquisitions

Mergers and acquisitions (as well as demergers and divestitures) are on the increase as companies struggle to adapt to the new competitive environment. It is difficult to name a major corporation which has not been involved, or reported to be involved, in some form of merger or take-over activity in recent years. This often calls for the fusing of different organisational and cultural structures, or (as for example, in the case of IBM) involves business units, previously insulated as part of the mother corporation, cut adrift to fend for themselves (210).

(c) Shorter product life/faster time to market

In many market sectors, the replacement (and possibly even the replacement for the replacement) for today's leading edge product is likely to be at prototype stage as soon as this product reaches the market. The development and introduction of Intel's 286, 386, 486 and Pentium microprocessors provide a good example. In the context of the financial services sector, Chorafas cites products which require a development process measured in weeks, and for which the market life may be measured in months (211).

(d) Volatility and unpredictability

Deregulation, globalisation of the marketplace, and economic uncertainty are just some of the factors giving rise to an unprecedented degree of business uncertainty and volatility (212). The airline and financial services industries are noteworthy in this regard, but the computer industry provides the best example. In the early 1980s, few could have envisioned the impact of personal computing, the decline of minis and mainframes, and the catastrophic effects these developments would have had on most of the computer industry's leading companies.

(e) The customer as king

The days of customer brand loyalty appear to over, or at least seriously in the wane. "Since the early 1980s, in the US and other developed countries, the dominant force in the seller-customer relationship has shifted. Sellers no longer have the upper hand, customers do. Customers now tell suppliers what they want, when they want it, how they want it, and what they will pay" (213). For companies accustomed to taking a loyal customer base for granted, this new environment has proved to be an unsettling experience.

8.4 The Need for a New Paradigm

These developments have placed unprecedented strains on corporate structures and profit levels. Keen states, for example, that "there is no major industry today where margins can be expected to increase in the coming decade" (214). It is on corporate structures however that the greatest impact appears to have been felt. This becomes clear if suitability of traditional hierarchical organisational structures are related to the dominant characteristics of today's business environment.

This environment as described above could be summarised as being one which is more challenging, unpredictable, and volatile, and in which the balance of power has shifted from the seller to the customer. Relating this to characteristics of the hierarchical organisation outlined earlier, it emerges that the strengths are not particularly well suited to these requirements, while the weaknesses, particularly those relating to inflexibility and lack of customer focus, are critical in terms of survival in today's market conditions.

This suggests that the hierarchical model may no longer be appropriate. Many firms are applying Business Process Reengineering (BPR) methods or a derivative in response to this new and unprecedented challenge. Peppard and Rowland state that "over the past few years the level of interest in BPR has exploded" (215), while Drucker refers to "the strenuous efforts of American corporations in the last ten years to re-engineer themselves" (216).

Conclusion 1: Traditional business methods do not adequately meet the challenges of today's business environment.

8.5. Business Process Redesign (BPR)

8.5.1 Process Redesign Defined

"Business reengineering offers an opportunity to make a step-change improvement in competitiveness - and then maintain and improve that competitiveness" according to Bartram (217) while Hammer and Champy describe it as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed" (218). Peppard and Rowlands define it as follows: "BPR is an *improvement* philosophy. It aims to achieve improvements in performance by redesigning the processes through which a organisation operates, maximising their value added content and minimising everything else. The approach can be applied at an individual process level or to the whole organisation" (219).

8.5.2 Components of BPR

While acknowledging a variety of definitions and methodologies for BPR, most have the following commonalties:

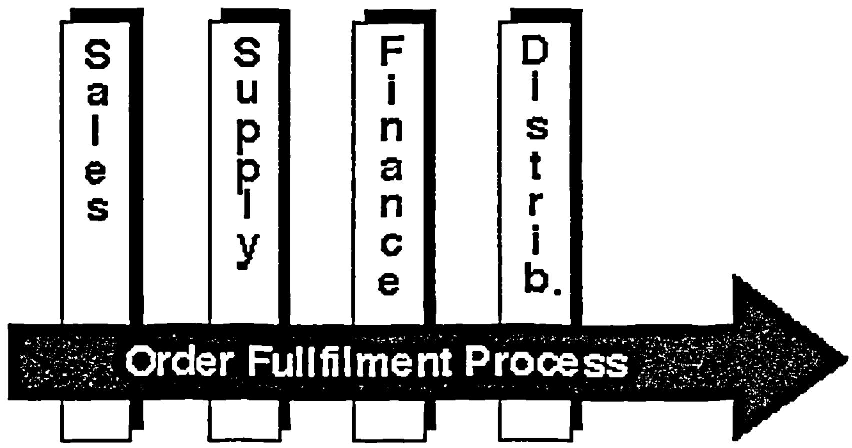
(a) Starting With a Clean Sheet
If it is accepted that traditional structures are fundamentally ill-suited to meeting current business needs, it can be argued that experience may often be a barrier to future business success. Drucker, in fact makes this very point. "The greatest obstacles are always the things you did well yesterday, the things you spent 30 years perfecting" (220). If this is accepted, it follows that only radical, fundamental change will be successful, and indeed, most of the leading thinkers on reengineering support this view (221).

(b) Emphasis on Processes not Tasks
The hierarchical form of business organisation operates on the basis of individuals carrying out specific tasks, based on division of labour principles. These tasks in themselves seldom achieve a given business objective, being merely components of the

process which achieves the objective. Thus the keying in of a customer order is a task, but order fulfilment is a process.

A process will frequently transcend functional boundaries within a firm. To take example of order fulfilment, the task of accepting the order may be performed by Sales, the order procurement task by Supply, the pricing task by Finance, and the delivery task by Distribution. A "process owner" or a "process team" must be empowered to undertake all the relevant tasks if the objectives are to be met. Clearly, this demands fundamental organisational change, suggesting that reengineering can only be successful in flat, process-oriented organisations.

Fig 8.1 Example of Business Process



(c) All Options Open

The concept of reengineering demands that all existing assumptions be questioned, in the light of the overall objectives of the organisation. Thus Hammer and Champy claim that "reengineering first determines what a company must do, then how to do it. Reengineering takes nothing for granted. It ignores what is, and concentrates on what should be" (222). The corollary to this is that all possible solutions must be accepted for evaluation, irrespective of the extent to which they depart from accepted norms.

8.5.3 The Benefits of Reengineering

Hammer and Champy cite truly dramatic improvements in a series of detailed case studies, among them IBM Credit, Bell Atlantic, Ford, Lucas, and Nabisco Foods. For example, Ford reduced the numbers involved in its vendor payment process from 500 to 125, IBM Credit reduced average turnaround time from seven days to four hours without additional headcount -in fact, a small reduction in headcount resulted. In the UK, Lucas Industries, Nabisco Foods, John Radcliffe Hospital (see case study on Appendix IV) and Gateway Food markets are some of the organisations which recorded, and continue to record, step-change improvement in performance through organisational reengineering.

A review of these organisations' case studies makes clear that the dramatic improvements in performance could have been achieved only through reengineering, and not by modifications or enhancements in the context of existing organisational structures.

9.5.4 The Drawbacks of Reengineering

The concept of organisational reengineering, particularly in its more formalised manifestations (most commonly business process reengineering, or BPR) has not met with universal acceptance. In the first instance, as Tapscott and Capston show, there are at least fifty methods and approaches to what is known as business reengineering. They add that many companies involved in reengineering have developed their own programs (223). Paul Strassman maintains that what passes for new thinking on reengineering is nothing but old industrial engineering methods of process analysis, activity costing and value-added measurement rebottled as a new science (224), while Earl and Kahn raise similar issues on originality (225).

Specific drawbacks have been identified in the following areas:

(a) Risk: All change assumes a degree of risk. The profound changes which a reengineering initiative attempts to implement suggest that such an initiative should be classed as high risk. Such changes demand the capacity for individuals to visualise their business in process terms, which in turn calls for a comprehensive understanding of the business and its people. Such individuals are difficult to find, and reengineering undertaken by less capable managers courts disaster. Hall *et al.* in a study on the impact of reengineering state "in all too many companies reengineering has not only been a great success but also a great failure" (226).

Self-contradictions: Reengineering literature and case studies endlessly cite the need for active staff involvement, discussions, flexibility, empowerment of the individual in the cause of greater organisational effectiveness. Equally common have been massive redundancies, outsourcing, loss of job security as exemplified by the sharp increase in the instance of short-term contracts, and other negative factors in terms of staff morale, (227). In effect therefore, reengineering demands staff to act like "turkeys voting for Christmas", in that they are expected to enthusiastically support initiatives with unforeseeable consequences for their own job security. Tom Watson, an acquaintance of the author, who played a leading role in British Nuclear Fuels' reengineering programme, made this point to the author in 1992. By a twist of fate, Tom was shortly to go the same way 4,000 of his colleagues had gone over the previous few years.

Legacy systems: Most organisations have a substantial proportion of their asset bases in the form of so-called legacy systems, (see Chapter 9) which, being based on older software and hardware platforms, are inherently inflexible (228). These systems embed key business processes in their software, so introducing radical change inevitably calls for radical change in the supporting systems. Yet redesigning and/or downsizing legacy systems represents a colossal job for any organisation (229).

Separation of work design from execution: This rather more profound objection to reengineering has been identified by Tom Davenport on the strength of much practical experience and academic research in the field (230). Davenport claims that "the classic form of reengineering calls for a small group of people to design work processes for a much larger group; there is little participation in the process by those who actually do the work". He adds that this is inherently inefficient in that no group, no matter how well informed, can possibly anticipate all eventualities in work design, but more fundamentally, the omission of those doing the work from the design phase can and does generate serious, possibly fatal, alienation.

There is little doubt that the success rate of reengineering has been questioned, and there have been a huge number of failures, to the extent that Jain, referring to 1994, suggests that "corporate America faces the prospect of $20 billion worth of BPR efforts going down the tube this year" (231). Nevertheless, even its most trenchant critics do not seem to claim that reengineering *per se* is unnecessary. The literature fails to show any significant body of opinion or research to support the contention that conventional approaches will met the demands of today's business environment. While many serious drawbacks to reengineering have been identified, and many expensive failures have occurred, these should be seen as part of the learning process in the move to a new business paradigm. It is proposed therefore that despite its shortcomings, reengineering in some (or possibly many) forms will continue to play an increasingly important role in corporations' attempts to adapt to the new business environment.

Conclusion 2: Organisations must restructure to meet the challenges of the new business environment, and reengineering is a vital element in this restructuring

8.6. Process Redesign and IT Investment Appraisal

8.6.1 The Need for a New Approach

The case will now be made that IT investment will be optimised when it is applied as an enabler in the context of reengineering business processes, and as such the reengineering perspective must form part of the appraisal process.

The weaknesses of the task-based, hierarchical organisational model were referred to earlier to demonstrate that it is unsuitable to meet the demands of today's business environment, particularly in the context of applying IT effectively. A new approach is therefore called for.

8.6.2 The Limits of Conventional IT Approaches

The evidence that only minimal, and decreasing, gains were being achieved by trying to make the old business model run faster gave rise to the need for a radical solution, hence the concept of reengineering. As was shown earlier, only by applying reengineering techniques could improvements such as those demonstrated at IBM Credit, Ford and Kodak could been accomplished.

A parallel can be made with IT. Irrespective of the computing power applied to make existing processes more effective, few if any would have been fundamentally improved in the absence of process reengineering. In the case of Ford, for instance, executives calculate that with enhanced computer support for the existing vendor payment process, headcount savings would have been in the region of 20%, rather than the 80% achieved by reengineering (232).

Hammer and Champy put it even more strongly: "As an essential enabler in reengineering, modern information technology has an importance to the reengineering process that is difficult to overstate" (233). Describing IT as "most relevant to BPR", Peppard and Rowlands state that "technology plays a leading role, along with processes and people" in the success of BPR (234). Venkatraman suggests that "while a new set of principles of organising (businesses) has not yet emerged, it is clear that the basics for business process redesign should at least be reassessed in the light of the new capabilities offered by IT" (235). John Donovan, one of the leading exponents of client-server technology in reengineering projects, sees IT as essential in all reengineering projects (236).

Conclusion 3: IT is an essential element in the reengineering process

8.7 Process Redesign - a new role for IT

Change the Mindset

The first requirement in achieving reengineering benefits through IT may be as fundamental as a changed mindset for IT staff, who have been conditioned to approach projects from the perspective of existing processes. In fact, in the author's experience working with Ford, the word "automate" was often used when referring to a systems development project, embedding the concept of *automating existing processes* in IT thinking.

At its most basic, this new mindset will accommodate IT staff in redesigning or reengineering new business processes rather than automating them. In this, IT skills such as analytical minds, structured methodologies, understanding information flows, and project management skills are invaluable resources in a reengineering project. IT as a business force can also contribute enormously, as Bartram's taxonomy shows (237).

Move From Deductive to Inductive Thinking

This new mindset should form the basis for an approach which offers the most spectacular possibilities for IT in the context of reengineering. This approach can be described as a move from deductive to inductive thinking or technology visioning.

Traditionally, most business problems, (especially those related to IT) have been addressed by way of deductive thinking. That is, the problem is defined, possible solutions are explored, and the optimum solution is selected on the basis of a variety of criteria. This is described by Teng *et al* as "automation typically uses machines and computers to speed up existing procedures, and the capability of the technology is applied within the constraint of the current business procedure" (238). Inductive thinking turns this approach on its head, in that it calls for the capacity to envisage the capabilities of a particular technological development, and then seek the business problems it might address (239).

This may appear to be breaking the golden rule of systems development, that solutions should be business rather than technology driven - the so-called "solution looking for a problem" syndrome. Whereas this is undoubtedly true for applications related to conventional DP or automation, it becomes valid, indeed a requirement, in the context of reengineering (240). This is because certain redesign possibilities will become apparent only if seen in the light of what Hammer and Champy call the disruptive power of technology. They go on to underline both the difficulties and importance in "recognising the new, unfamiliar capabilities of technology instead of its familiar ones". This difficulty stems largely from the propensity of organisations to view technology through the prism of their existing processes and practices.

Hammer & Champy provide a rich taxonomy of potential applications for this disruptive power of technology, but an example often serves best to illustrate the concept. One of the best known relates to the invention by the Xerox Corporation of the photocopying machine around 1958. Feeling it was not adequately resourced to undertake the commercial marketing of the product, it offered the patents to IBM, which commissioned a leading American firm of consultants to undertake a market research study. The study was postulated largely on the basis of the copier replacing the use of carbon paper (the standard copying mechanism at the time), and was no doubt carried out efficiently. The conclusion, again undoubtedly correct, was that even if 100% of the market for carbon paper were captured, the proposal would not be commercially viable. IBM rejected the chance to enter the photocopying business. It is clear, with the benefit of hindsight, that the photocopying technology created a market, one that was not envisioned at the time. It created a market because by enabling many people to simultaneously use, and retain, a copy of a document, the first Xerox photocopier opened up a whole new way of doing business. Inductive thinking or technology visioning, properly applied by IBM at the time, could have identified the enormous potential for the technology. Instead, by viewing it through the prism of existing processes, the opportunity was lost (241).

Provide an Appropriate IT Architecture

Frank O'Marrs, partner-in-charge, continuous improvement at KPMG Peat Marwick, sees an appropriate IT infrastructure as a prerequisite in a reengineering project. This organisation undertook a radical reengineering project, and O'Marrs emphasises that "the <u>first step</u>... is to develop a standard computing infrastructure throughout the firm that will allow our professionals to effectively share information and communicate

across lines of business". This is supported by that company's chief executive Jon C. Madonna, saying that "information technology is fundamental to our new strategy" (242).
Key requirements for reengineering have been identified as:

Flexibility: The capacity to develop an IT solution quickly is an essential element of many reengineering initiatives, and this in turn calls for a flexible and responsive IT architecture (243). Donovan argues that the flexibility provided by a client/server environment is essential for successful reengineering projects, and as has been shown earlier, the inflexibility of legacy systems poses a major threat to reengineering projects (244).

Robustness: Business process reengineering will often impose significant strains on an IT infrastructure, as, of its essence, process redesign entails change of a fundamental nature (245). New or untried operating or database systems, an assortment of networks or communications protocols, low levels of integration between applications, inadequate security and backup procedures all undermine the robustness of an infrastructure.

Openness: The capacity to look outside the confines of the firm (primarily to customers and/or suppliers) often provides the best reengineering opportunities (246). An open architecture and an adherence to industry standard communications protocols are key features in this regard.

Conclusion 4: The role of IT in the context of business reengineering is different to that in conventional applications

8.8 Consolidation

The four conclusions drawn so far are:

<u>Conclusion 1:</u> Traditional business methods do not adequately meet the challenges of today's business environment.
<u>Conclusion 2</u>: Organisations must restructure to meet the challenges of the new business environment, and reengineering is a vital element in this restructuring
<u>Conclusion 3:</u> IT is an essential element in the reengineering process
<u>Conclusion 4</u>: The role of IT in the context of business reengineering is different to that in conventional applications

It is reasonable to propose therefore that the potential impact of reengineering should be taken into account when appraising new investments. A striking example of this occurred at one of the 'smokestack' industries which formed part of the research. A product handling system which was at the sign-off stage was assessed under the reengineering perspective. It was found that the capacity to reengineer processes (although this was not the terminology used) had a high priority within the company, particularly in those departments interfacing with the customer. Flexibility, adaptability, and the capacity to respond rapidly to customer or legislative initiatives was deemed highly important. Yet the proposed new system, while offering cost savings, enhanced customer service and improved management information, in effect embedded underlying work practices in the software. Inefficient as the old manual system was, it nonetheless could be altered by simply instructing the workers, and/or by introducing new workers. The net effect of the system being introduced would be a sharp diminution in reengineering enablers. This finding resulted in the introduction of the system being postponed, although it was introduced later with significant modifications. Roach has also demonstrated that the huge investment in service industries in the USA in recent years has resulted in a loss of flexibility. "The bottom line is that service companies have moved from a variable-cost to a fixed-cost regime, thereby sacrificing flexibility without gaining any concomitant productivity benefits" (247).

For reasons such as this, reengineering has become a major issue for IS managers, and is assuming increasing importance as is borne out by some of the latest research available. A project conducted recently in the United States by Lederer and Mirani to assess the most important factors driving IT investment found that business redesign outnumbered the three next most important factors combined, as is shown on Table 8.1. (248).

Table 8.1 Most Important Factors

Factors	Number of Projects
Business redesign	98
Improved information	29
Strategic advantage	17
Reduced workforce costs	20
Reduced technology costs	16
Return on investment	27
Better applications development	15
Adherence to Govt. regulations	35
Reduced travel costs	3

Process redesign is therefore proposed as a perspective in its own right in the evaluation framework, and it is suggested that the foregoing provides strong substantiation for this. Somewhat surprisingly, given the high profile of the reengineering concept, and its accepted dependence on IT, it forms part of none of the frameworks reviewed. The only framework assigning any significance to the concept is *Information Economics*. In the discussion on the value concept, the authors state that "the real benefit of information technology results from change in the business. IT changes products, markets, management styles and organisational structures. Without change there is no benefit" (249).

Summary

The competitive pressures of today's business environment have rendered traditional models of business organisation obsolete. Attempts to improve performance of this model, even when enhanced by IT, have resulted in only marginal improvement, and have contributed to the poor performance of IT in terms of investment returns. Only by reengineering operations around processes rather than tasks can this problem be addressed. IT is seen, not only as an essential element in achieving this objective, but its powers must themselves become a catalyst for change. In other words, IT must be deployed in new and original ways under reengineering. Despite the importance of the reengineering concept, little attention has been applied to it in existing frameworks.

Chapter 9. The IT Architecture

9.1 Introduction

IT architecture is a term which, though widely used, suffers from a range of interpretations. Earl describes it somewhat lyrically as the "processing power of computers, the highways of telecommunications, the foundations of data, and the fabric of basic business systems" (250). In practice this means a company's computers, software, databases, telecommunications, programming languages and operating systems and the relevant standards for each of these entities. The architecture to a large extent defines what a company can achieve, not only in IT, but also in business terms. As Brandt Allen, a leading American business analyst put it recently, "*the decisions managers make today about their IT architecture will determine their organisation's ability to respond to challenges and opportunities for many years to come*" (251).

9.2 The requirement for an Architecture *perspective*

1. Enabler of core business functionality
Almost all businesses today rely heavily on IT to enable their core business applications. Accounting, order processing, manufacturing, inventory control and payroll are now almost universally computerised. The architecture must be adequate to support these requirements not only currently, but for a number of years hence. Waiting until forced by circumstances to provide the appropriate elements is likely to result in less than optimum investment performance. The author witnessed this in the course of two consultancy assignments in which companies were forced, due to an exclusive attention to applications software and immediate financial payoff, to replace fundamental components of the IT architecture without the benefit of adequate planning or investment appraisal. This decision gave rise to major problems in the medium term (see Appendix I).

2. Support for Business Flexibility
Heraclitus is not a name that readily springs to mind when discussing IT architectures, but he identified in 470 B.C. what is becoming increasingly apparent to every businessman, and IT specialist today - "nothing is permanent but change". Shorter time to market, shorter product development and life cycles, rapidly changing organisational structures, deregulation (with its unpredictable outcomes), and volatile consumer will represent at various times, threats or opportunities. However, they will always impose

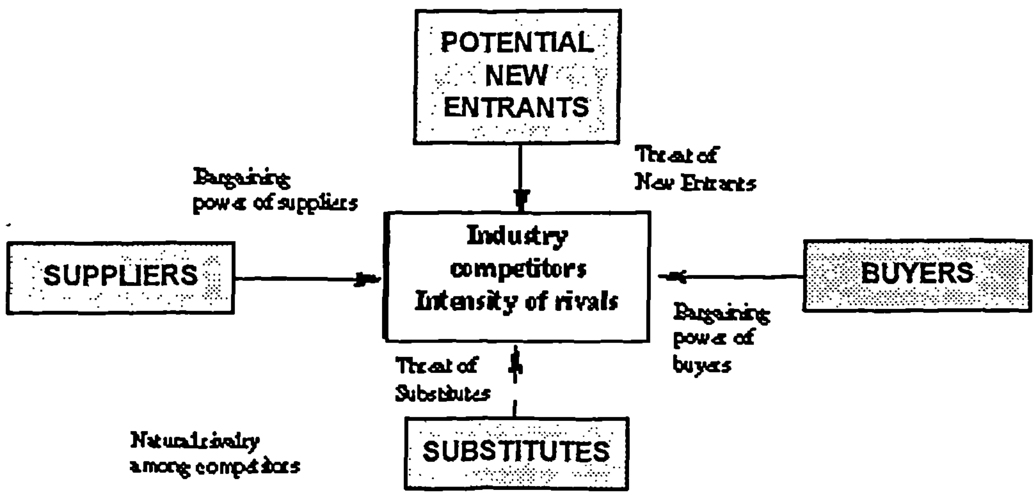
demands on IT to provide rapid and adaptable business solutions. Whereas impressive results can be achieved in the short term by adopting a case-by-case approach independent of the architecture the inevitable obstacles they pose to systems integration suggest that the desired flexibility can be achieved only on the basis of an appropriate architecture.

3. Support for Competitive Positioning

Competitive positioning is more often associated with applications than architecture, but the latter can be crucially important here as well. Whilst the architecture itself may not be the crucial factor (it can after all be replicated by competitors), taken in conjunction with innovative applications software it can be the source of decisive competitive advantage. The reverse side of this of course is that such competitive initiatives can be employed by competition as well. The range of potential considerations is graphically outlined in Fig 10.1. (252).

Fig 9.1 Business Impact of Competition

The Five Competitive Forces



One of the most widely quoted examples of IT architecture deployed for competitor lockout is that of American Hospital Supply (AHS). By installing a vast telecommunications network with their customers, giving them direct access to their inventory and order-replacement systems. During the years 1978-1983, AHS's revenue grew by an annual average of 17%, while the industry overall suffered a decline (253). Even more impressive has been American Airline's SABRE online reservations system, which rivals the airline itself in terms of profit contribution, greatly reduced the airline's operating costs, and was so successful that legislation was introduced in the US Congress to force American to share the facility. Braniff Airlines and People's Express both went bankrupt due (at least in part) to the impact of SABRE and to corporate decisions not to invest in similar infrastructure facilities (254).

4. Enabler for Strategic Realignment

It has been demonstrated throughout this work that turbulence and unpredictability characterise today's business environment to an unprecedented degree. One notable affects has been the blurring of boundaries between hitherto clearly differentiated industries and market sectors (255). A second has been the extent to which traditional manufacturing industries have struggled to adapt to this new environment (256).

These outcomes have resulted in many corporations (particularly those engaged in traditional manufacturing) realigning their strategies towards service activities. This has been described as industrial-age firms moving into information-age markets. A notable example is the move by major publishers such as Simon and Schuster into software retailing as well as electronic publishing and electronic distribution of data services, newsletters and books (257). GM and Ford have moved into the financial services, by way of funding dealership parts and vehicle inventories, as well as computer assisted manufacturing and software services (258.) The capacity to undertake these moves has been dependent to a greater or lesser extent on an IT architecture which has had to be flexible, expandable, and robust. An examination of the 10 routes that Canton has identified for making the transition to services shows that IT architecture is an essential enabler (259).

5. Enabler of Alliances, Mergers and Take-overs

Electronic linkages between the information systems of different companies are rapidly increasing in number. Keen states that "in the 1990s, on-line operations will naturally, rapidly, and inevitably be extended across organisational boundaries, with IT as the key enabler. A firm whose IT base meets only its internal needs will be at an obvious disadvantage" (260). The capacity of the IT architecture to adapt to the demands of EDI and the numerous industry-specific standards such as the US grocery industry's uniform communications standard (UCS) will therefore be crucial. Keen goes on to cite the example of a US bank which lost a $400 million client because it could not link its payments system to that of the customer.

Mergers acquisitions and divestitures are now an everyday fact of life (see Chapter 7) Hardware platforms, operating systems, network protocols and database management systems are just some of the architectural elements which are capable of making or breaking a proposed merger. When British Airways took over Caledonian, the two airlines' systems were integrated over the space of a weekend, due to the compatibility and flexibility of their IT structures. By way of contrast, the mergers of Continental and People Express brought chaos due to incompatible IT structures (261).

6. Potential to Optimise Supplier Alternatives

The selection of suppliers of the IT architecture is much more problematical in the 1990s than it has been in earlier times (see Chapter 3). Up to about the mid-1980s, most architectures (apart from those in very large organisations) would be dominated by one, or at most two, suppliers. Those suppliers would have provided a stable development environment, and, due to the relative stability of the marketplace, generally have been financially sound, and would have provided a relatively stable growth path. Today, even the giants of the IT industry, such as IBM and Digital, have had to struggle, not just for their market positions, but for their very survival (262).

These conditions underline the increased importance of choosing carefully when selecting the suppliers of the IT architecture. It is now much easier to (end up in) a technological cul-de-sac, or with a supplier whose current financial stability may prove to be short-lived. In today's competitive trading conditions, these possibilities could be crucial.

For these reasons it is proposed that architecture represents an essential element of the investment appraisal process.

9.3 Architecture issues in the appraisal process

9.3.1 Outsourcing

Definition

Outsourcing may be described as the transfer of all or part of a firm's systems/DP operations to an outside contractor. It is one of the most widely discussed issues in recent years, and while the number of firms which have engaged in major outsourcing operations to date has been small, interest is high. A US survey of 500 IS managers found that only 2% of respondents were actively using outsourcing, but 20% were considering such a move (263).

Outsourcing Drivers

Pressure on IT costs: The lack of any demonstrable proof of payback from IT, despite falling hardware process, has led to pressure from senior management on IS managers to reduce costs (264). Looked at solely from this perspective, outsourcing will undoubtedly reduce costs, at least in the short term.

Greater IT complexity: Trends such as distributed computing, multi-vendor installations, and a profusion of "standards" have greatly complicated the lives of IS managers, as have the presence of different operating systems, incompatible applications software and development tools in the one site (265). The rate of technological change demands that IS managers risk losing their grip on their environment when they become bogged down in administrative details (266). "A growing number of consultants, corporate executives, and IT professionals say a solid understanding of technology is once again becoming crucial for ... IS managers...to help companies (develop) an infrastructure for the 21st century" (267). Outsourcing is seen as enabling IS managers concentrate fully on such issues.

Hedging infrastructural risks: IT infrastructural planning has become much more difficult to predict than heretofore (see Chapter 3) as different architectures, operating systems and platforms struggle to achieve supremacy. Decisions taken on architecture investment could result, not only in significant financial losses directly related to the investment, but, given the pervasiveness of IT through all business operations, could seriously undermine a firm's ability to competei (268). Outsourcing is seen as a form of insurance, or less charitably, a way of avoiding risky decisions.

Even though in many ways it can be seen as harking back to the 'bureau' activities common in the 1960s, the appeal of outsourcing is very much a function of current trends in IT. To an IS manager faced with the difficulties outlined above, it has many appealing qualities, not least in that it can avoid or postpone difficult decisions in the investment appraisal process. The following are issues which should be considered if outsourcing is being considered as an alternative to purchasing:

Timespan: For very good reasons (from their perspective) outsourcing contractors will seek to long term contracts, usually for a minimum of five years, and most outsourcing contracts are for ten or even fifteen years (269). The rapid rate of technological change as well as the need to align business and IT strategies, and the INDUCTIVE role of technology in enabling process redesign have already been considered in Chapter 8. Clearly, tying a company to a long term contractual arrangement, based on today's technology, is potentially highly restrictive in terms of these requirements. Irrespective of how carefully an outsourcing contract is constructed, it is difficult to see how a "partnership" could be satisfactorily maintained over this length of time unless the outsourcing organisation is prepared to forego future flexibility.

Staffing: Outsourcing decisions, involving staff being redeployed either internally or externally, or laid off, "can lead to personnel problems and even class-action lawsuits" (270). Staff who are redeployed to the outsourcer may in theory remain available, but this ignores the possibility that they may not remain with the outsourcer, or might stay but pursue a different career path. The possibility of breaking up a good in-house team is therefore strong, and at a minimum, in-house staff morale will almost certainly be adversely affected.

Confidentiality and Integrity of Data: One of the reasons which contributed to the virtual disappearance of computer bureaus related to reservations about data security, confidentiality and integrity (271). With the vast increase in the amount of data, and the introduction of new legislation governing privacy and use of data, these reservations assume increased significance. Notwithstanding much talk of "partnerships", an outsourcing arrangement involves handing over control of a vital corporate asset to strangers.

Data deluge: One of the main advantages of personal computing, the availability of large amounts of additional information, could turn out to be a problem of assimilation. The Gartner Group put it strongly "With some IS organisations opening the data flood-gates...giving users unbridled access to data - a problem far worse than restricted access has risen: data deluge. Data deluge will reduce user decision-making capability by more than half" (272).

Impact on Architecture Investment Perspective

It is too soon yet to determine the full impact of outsourcing, as there are few if any such arrangements which have been in place longer than a few years. On the basis the advantages and risks detailed above, it would appear that the real impact will only become clear after several years (five or more) years. On balance it would seem that outsourcing all or a substantial part of the IS function would impose unacceptable limitations on organisational flexibility, outweighing the apparent benefits. Even routine transaction processing can give rise to problems, as enterprise-wide information systems increasingly gain currency.

On balance, then, it is suggested that, if IT is to act as a strategic resource, the IT infrastructure should remain in-house, despite the attractive short term advantages associated with outsourcing.

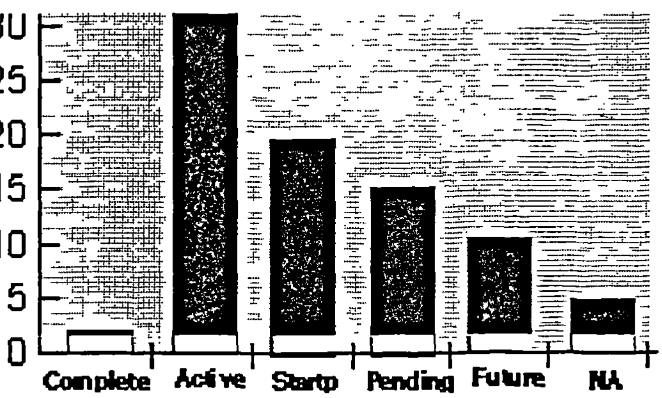
9.3.2 Legacy Systems

Definition

Legacy systems may be described as applications which were developed on older technologies, usually minis or mainframes, using old programming languages (such as COBOL, FORTRAN, and Assembler), and "is past its prime but is too critical to disrupt" (273). In terms of the Four Phase historical development of IT (see Chapter 3), legacy systems would relate to those at Phases II and II. This would be similar to Stages 1 and 2 of the Butler Cox Foundation's Four Stage IT Impact framework. Stage 1 relates to functional automation applications, such as replacing clerical processing of payroll. Stage 2 systems are characterised by sharing data between different business functions, as for example payroll transactions being integrated into the general ledger system (274). Such systems are typically ten to fifteen years old and are characterised by enormous growth throughout this lifespan. *Information Week* cites examples of applications which have grown tenfold over their lifetime, including one for the Chevron Corporation where one COBOL programme grew to encompass over 3 million lines of code (275). This growth suggests an enormous expenditure on maintenance tasks over time dwarfs the original cost (and cost justification) of the original application. More seriously, it suggests that essential business requirements may remain unfulfilled due to development staff's involvement in maintenance.

The scale of existing investment in such systems is enormous (estimated at up to $2 trillion), as is the cost of moving from them ($17.6 billion in the US alone for 1993), and to compound the problem, the cost is increasing at the rate of 18% per annum due to continued growth in size and complexity (276). It is little wonder then that the issue is becoming one of increasing concern for IS Managers. This concern is reflected in the number of departments planning legacy systems replacement projects, as indicated in Fig 9.2.

Fig 9.2 Firms Contemplating Legacy System Replacement



The Imperatives for moving from legacy systems

In many ways, the problems associated with legacy systems parallel those of the minis and mainframes on which they operate:

They go back to a time when the proportion of cost related to hardware as distinct from staff costs was much higher than it is today. This facilitated the build-up of an inflexible bureaucracy around both the hardware and the systems (277). Both the hardware and applications were geared towards high volume batch processing, with minimal end-user interaction. The basic architectures of both hardware (particularly mainframes) and software have changed little over twenty years (278). Many of the biggest suppliers of minis and mainframes have experienced severe financial difficulties as their market eroded (see Chapter 3). Most seriously however, they are singularly unsuited to the demands of today's business environment:

Shorter product development cycles and market life demand flexibility and speedy software development.

The spread of IT through all business processes calls for hybrid skills among systems staff. Such skills are in notably short supply among those who develop, maintain, and operate legacy systems (279).

Process Redesign has been shown (Chapter 8) to be one of the key business requirements of the nineties. "As business reengineering moves from definition to implementation, IS managers find legacy systems standing in the way. Business processes are like bricks, they can be stacked and sorted any which way. But a legacy system is like mortar cementing the bricks in place. BPR can't be done without chipping away the mortar" (280).

Empowering of end-users, a key business requirement of the 1990s, calls for intuitive interface, easy access, and attractive output.

Eroding profit margins call for cheaper operating platforms.

The growth of IT-enabled links between companies (e.g. EDI) requires open standards and flexible response.

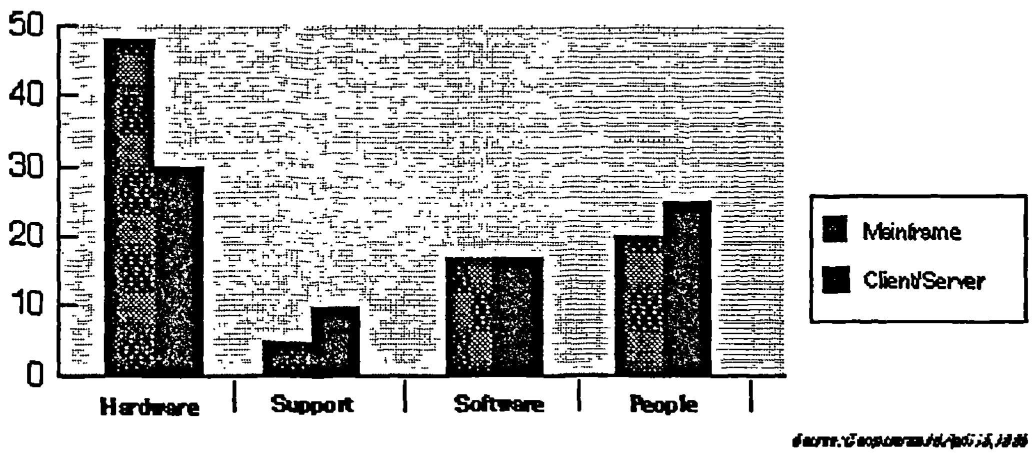
Clearly legacy systems, and their concomitant hardware platforms, have limitations in meeting such requirements. Hence the compulsion to move to a more appropriate environment. Paradoxically, some of these pressures may have the effect of prolonging the life of legacy systems. For instance, eroding profit margins and general business uncertainty have resulted in a reluctance to undertake the large and risky investment required in moving from legacy systems, and the demands of users for the speedy provision of information results in further maintenance, rather than a "ground up" shift to a modern environment (281).

Balancing the Benefits

Processing Costs: Despite frequent claims to the contrary, moving from mainframes to client/server does not automatically imply cost savings. This depends very much on the type of applications in use. When there are large numbers of users, and computing requirements of the user are low. An example would be an airline reservation system with a high number of agents involved in simple inquiry and update tasks. This reflects the fact that terminals are much cheaper than workstations (282).

Storage Costs: While client/server storage devices are substantially lower than those for mainframes in terms of direct cost versus capacity, this masks variances in performance. For a database application, client/server technology often requires that the database reside on a single disk. This curtails the potential efficiency gains applicable in a main-frame environment, where disk performance can be optimised by allocating the database over numerous disk drives (283).

Fig 9.3 **Relative Costs for Mainframe and Client Server**



Interfaces: A client/server environment usually involves implementing interfaces between networks, databases, different operating systems, user interfaces, and hardware platforms. The laws of complexity come into play here, invariably adding dispropor-tionately to costs and maintenance.

Systems Management: Tools such as performance monitoring, capacity planning, print management, library management and security are essential for efficient operations, and are standard in a mainframe environment. These are either unavailable, or still relatively immature in the client/server environment (284).

Despite these seemingly unfavourable comparisons to mainframes, the move to client/server must be seen as inexorable. Herb Edelstein, a leading consultant in this area, summarises the reasons as follows: "the benefits ultimately outweigh the costs". He cites these as a better user orientation, scaleability of applications, and the flexibility to meet a dynamic, distributed business environment" (285).

Impact on Architecture Perspective

In terms of investment appraisal, the move from legacy systems must be seen as complex and time consuming. Computerworld states that "(u)sers and industry analysts say even relatively straightforward integration projects, such as a simple client/server query application, can easily take more than a year". It goes on to cite other difficulties, most notably those related to keeping corporate data shared among different platforms synchronised, and the "culture shock" for IS staff making this transition (286). Probably the most important issue from an investment appraisal perspective is whether to continue to invest in legacy systems, or "bite the bullet" and downsize or outsource. Given the scale and scope of existing legacy systems, and the trend in technology, this is likely to be one of the key factors facing management over the next number of years.

9.3.3 Centralisation versus Decentralisation

This is one of the most enduring and widely-discussed issues, and has been debated at length for many years now, and some researchers see it as a key determinant of IT investment effectiveness (287). Lincoln describes the centralised organisation as one which "determines to retain central control over resources, planning, service delivery, etc. In spite of processing some elements of multi-divisionalism". The decentralised organisation on the other hand "runs its divisions at arms length, and operates as a remote holding company" (288). The fact that it remains a subject of such debate suggests that IS managers should afford it careful attention as part of the Architecture perspective.

Considerations

Advantages of a decentralised architecture

- Meets a key requirement of modern business in that it empowers the end-user by providing flexible and fast response, as well as shorter and less demanding development cycles (289).
- Can be upgraded progressively flexibly in line with changing organisational requirements.
- Does not require a large number of expert (and therefore expensive) staff to operate and develop the applications.
- Is more likely to creates a sense of ownership of systems.
- Reduces corporate exposure to major centralised disaster (e.g. fire)

Disadvantages of a decentralised architecture

- Fails to achieve the purchasing economies of scale obtainable with a centralised system.
- Gives rise to problems of integration between different applications, and between applications and host systems. These can be very severe. Even Digital, the leading supplier of minis (the mainstay of decentralisation) had to undergo a major restructuring in the UK in the mid 1980s to overcome this difficulty (290).
- Will almost inevitably incur hidden and unanticipated costs (training, business disruption, inefficient software development, etc., as detailed in Chapter 3)
- Through unanticipated additional demands from users, hardware and network performance may prove to be inadequate.
- Does not facilitate the development or running of large-scale applications.
- Support from suppliers is unlikely to be as good as for centralised systems, due to the lower purchasing levels.
- Standards of security and data integrity are likely to be lower than in centralised processing (291).
- Despite widely held views to the contrary, moves towards decentralisation may result in an increase in middle management bureaucracy and numbers (292).

Cash *et al* take a more strategic view of the issues, and neatly summarise them in Fig.

9.4. (293).

Fig 9.4 Pressures on Balancing the Hardware/Data Distributions

Pressure	Towards Increading the Hub	Towards Increasing Distribution
Management Control	Flexible backup Efficient use of personnel More professional operation	User control User responsiveness Simpler control
Technology	Access to large-scale capacity Efficient use of capacity	Improvement in local reliability Efficiency of small scale
Data	Multiple access to common data Assurance of data standards Security control	Reduction in comms. costs Easier access Fit with field needs Data relevant to only one branch
Professional Services	Availability of specialised staff Reduced turnover disruption Richer career paths	Stability of work force User career paths
Organisational Fit	Corporate style: centralised Corporate style: functional IT centralised from the start	Corporate style: decentralised Business need: transnationals.

Impact on investment appraisal process

The issue of centralisation is seen by many practitioners as a key element in addressing IT costs. Claude Marais, a director in a $multi-billion US pharmaceutical firm, says "improving value from and containing costs in information technology are still among the top priorities for corporate executives. The way to do this is through centralised IT" (294). Others take a different view. "Decentralisation is the answer" claims Stuart Lieberman, a veteran of exercises in centralisation and decentralisation (295).

9.3.4 Open Systems

Definition

The term 'open systems' is not necessarily one which means the same thing to everyone. Two characteristics described by Tapscott and Caston seem to have a wide acceptance in the literature (296).

For a system to be open it should posses the following characteristics:
Portability: It should be capable of operating on a variety of hardware and operating sys-

tem platforms.
Interoperability: It should be capable of communicating and transferring data with other applications.

Other observers have included a standardised user interface, i.e., the capacity to minimise familiarisation requirements for users of other systems, as an additional characteristic (297). The Institute of Electronic Engineers offer a single-sentence definition. "A comprehensive and consistent set of international IT standards profiles that specify interfaces, services, and supporting formats to accomplish interoperability and portability of applications, data and people" (298).

Development of Need for Open Systems

The pressure for Open Systems derived almost exclusively from the user community, increasingly dissatisfied with the 'vendor lock-in' syndrome which applied up to the mid 1980s (299). This occurred due to a lack of portability of applications, whereby those developed for a particular manufacturer's hardware could not be ported onto that of an alternative manufacturer without involving enormous redevelopment costs and staff retraining and business disruption. This placed the customer in a weak position vis-a-vis the vendor, was cost inefficient, and reduced flexibility.

The pressure for Open Systems was reinforced by the following developments:

- The growth in distributed and personal computing gave rise to what could be described as a parallel world in which localised islands of processing and information existed in tandem with that of centralised minis and mainframes. This led to increasing demands for easy access to core corporate data resources, and for integration between the different operating environments (300).
- The growth in electronic linkages between suppliers and customers was hindered by an inability of different systems to 'talk' with one another. Even where it was possible, it demanded costly and complex interface mechanisms (301).
- Business pressures of the 1980s called for IT flexibility and better value for money. (see Chapter 8)

These developments have resulted in the rapid growth of open systems, making one of the most important issues for IT managers to address today (302).

There is a more profound dimension than this however to the concept of openness, in that a different philosophical approach underpins it. This philosophy envisages an environment where barriers are reduced, thereby enhancing connectivity and co-operation, where dependence on powerful suppliers is eliminated, where, through open connectivity, co-operation with customers and suppliers is enhanced, and through supporting greater flexibility and mobility of staff, where new technology and adaptive IT solutions can be incorporated relatively seamlessly.

There are many parallels with the business environment, with openness underpinning many of the elements of the Phase IV business imperatives (see Chapter 3). An open business organisational structure suggests the following:

- the decision-making process becomes more transparent
- information becomes more readily available
- staff can move more freely between different tasks and processes
- supporting IT facilities can be altered more easily
- operating links can be more easily established - and broken - with customers, suppliers and even competitors
- short-term requirements can be accommodated more easily
- process redesign and the formation of process-based teams are facilitated

Investment appraisal ramifications of open systems

Although the Open Systems environment offers considerable benefits in terms of price, flexibility, and independence, in terms of the IT architecture it presents a bewildering array of alternative applications, operating systems, networks, and suppliers, all of which claim to be 'open'. In terms of downsizing to an open (usually client/server) environment, there is no guarantee of cost savings. The Xephon Group and others have shown that factors such as cheaper cost of MIPS (millions of instructions per second) and lower storage costs can be an inadequate way of assessing the full range of costs and benefits (303). In one publication, the use of such criteria is described as "judging a forklift on how fast it goes from 0-60 m.p.h.!" (304). A variety of hidden costs and poorer than anticipated performance have been identified as possible downsides of this environment (305), but the trend seems inevitable, and more a wide range of commentators sees the benefits arriving when a critical mass of experience in the environment has been reached (306).

9.3.5 Client/Server

Client/server technology represents a fundamental shift from its host-based predecessor. The host-based environment retained all power and intelligence at the centre - the host. Users connected to it via so-called dumb terminals which made no allowances for users' individual preferences or capabilities. The client/server model, by way of contrast, enables processing power and information appropriate to the users needs to reside on the users' workstation (the client), and additional information and processing capability is made available from a variety of specialised, dedicated servers, such as database servers, providing printing, database, document imaging, and other such services (307). Closely allied to the principles of client/server are distributed computing and co-operative processing, which involve locating applications and information on a variety of platforms, geared to usage requirements (308).

The business parallels for client/server are less numerous than for openness, but are nonetheless significant.

- Appropriate power and information is distributed to the user,
- Process-oriented work teams act as both as clients and servers
- Rapid, *ad hoc* solutions can be created when empowered staff have access to "servers", be they other specialised staff, or the resources of other process-based teams.
- Customised individually-tailored solutions are more easily developed in a client/server environment.

Tapscott and Capston provide a useful description of client/server in action, based on the Logical Service Unit (LSU) model (309). As the name implies, LSUs are based on the concept of *processes* as defined in Chapter 8, or more accurately, as functions (e.g. Order Processing as distinct from Order Department). A good example would be the Clinical Directorate function as described in the case study in appendix IV, and a typically an LSU would be a high level process such as production and delivery or promotion and selling.

Referring to the relationship between LSUs and external business associates, they recommend that "(i)t is useful to view these relationships as *client/server* interactions. For example, a request for product availability from a prospective customer would be serviced by a customer service LSU, which would then become a client of a warehouse management LSU to determine the in-stock status, which, if not in stock, becomes a client to the production management LSU to request an expedited production allocation. Each of these client/server interactions proceeds (it is hoped, in real time) using the established request-for-service format with expected responses and time frames pre-established."

Investment appraisal ramifications of client/server technology

Given the significance of the changes that client/server technology introduces to not only the IS department but throughout the organisation, it clearly has major ramifications for the investment process. It impacts other perspectives more than any other of the architecture issues, particularly those of risk and reengineering. The issue of costs and pay-back in a client/server environment are also a matter of serious contention at present, with one side claiming major cost savings, while the proponents of more centralised, host-based systems claming that a move to client server involves considerable additional costs (310).

9.3.6 Object-Oriented Programming Systems (OOPS) or Object Technology

Object technology defined

Object technology has been defined in a special edition of *I/S Analyser* as follows: "The reusability of software components into modular, interoperable pieces, which when put together accomplish a desired process, is the mother of object technology. ... an Object Request Broker (ORB) provides mechanisms by which objects (a combination of a state and a set of methods that embodies an abstraction) transparently make and receive requests and responses (e.g. an application object, or client, sends a message to another application object or server, requesting some action or service. The ORB fields the request and finds the object, conveys the request and selects a method to perform the requested operation" (311).

How is object technology different?

Unlike conventional procedural programming languages, an OO based program is comprised of numerous objects, which are made up of both program code AND data, thereby making them internally self-reliant. These objects can pass messages to one another, and as different programming requirements arise, can be amended slightly to meet these needs (312).

Thus a screen design object which would have the code and data inbuilt, could be taken and adapted slightly to provide the new screen design object for a different application. This is the concept of inheritance, central to OO theory.

The significance of OO

According to DataPro, "Object technology has become one of the most important new technologies of the decade" (313). Christopher Stone, President of the Object Management Group, claims that "open technology will change the way we develop, market, and sell computer technology" (314). The literature reveals a range of benefits and dis-benefits associated with this technology (315).

Benefits

- provides reusable code
- imposes a consistent development environment
- reduces development lead times
- reduces maintenance burden and errors in the maintenance process

Drawbacks

- calls for fundamental retraining of programmers
- payback is slow

Investment appraisal ramifications of object technology

Although properly a technical issue, the accepted importance of object technology over the full software lifecycle, from design through to marketing, must make it an issue for management when investing in information technology (316). The relatively slow payback and subsequent reduction in software maintenance costs directly impact on the investment appraisal process.

Summary

The review of the five perspectives suggests that management should seek to achieve the following when investing in the architecture. The architecture should:

- be flexible enough to accommodate the rapidly changing demands of today's business environment, yet sufficiently robust to support mission-critical applications
- provide the basis for competitive advantage through the application of technology, yet include the capacity to respond rapidly in the event of a threat of competitive technological lockout - in other words to be able not only to apply competitive lockout but also to respond to lockout initiatives by competitors.
- maximise the economic benefits and independence stemming from utilising a range of vendors, yet avoid the risks of incompatibility and vendor financial instability.
- provide adequate security and data access controls while minimising user inconvenience.
- provide maximum practical protection for existing investments yet be in a position to exploit new technologies as they come to fruition.

Investing in the architecture calls therefore for a skilled balancing of resources in meeting what are in effect competing business requirements. What meets one objective may conflict with others (e.g. flexibility conflicts with integration and security). And this must take place in the context of great uncertainty regarding future technological directions and continued rapid technological advances. Furthermore, current operational requirements have to be fully accommodated. If one takes into account the wide range of potential starting positions (the spectrum ranges from that represented by long-established legacy systems, to a greenfield site), the scope for prescriptive solutions is clearly limited. This perspective therefore provides considerable challenges to management seeking to optimise investment, and has particular relevance for the issue of investment scope raised in Chapter 11.

Chapter 10. Evaluating Risk

10.1. Introduction

As for all investment decisions, those related to IT incur an element of risk and uncertainty to a greater or lesser degree. Some textbooks differentiate between risk and uncertainty, but this distinction is not regarded as relevant to the purposes of this research. A more management-focused approach is offered by Loudon and Loudon, who describe risk as a negative outcome that has a known or estimated probability of occurrence based on experience or some theory (317). Further references to risk will therefore be in the context of what is commonly understood to be risk. Typical examples would be failure to implement on time, costs being greater than anticipated, poor performance of the hardware, system specifications not meeting user requirements, and organisational disruption.

The high level of failures identified in Chap 1 demonstrates that level of risk associated with IT investments, and a study by the OTR Group in 1992, quoted by Willcocks, showed that for projects in excess of £660,000, 90% were over budget, 60% were over time, and 20% were inappropriate" (318). The scale can also be enormous. For instance, projects abandoned in 1992 by the Wessex Water Authority and the London Stock Exchange resulted in billions of pounds being wasted. Emphasising the importance of risk assessment, Strassman claims that "performing risk analysis of computer opportunities is the most urgent challenge facing executives who must make informed investment decisions" (319).

Despite this, the proportion of companies applying risk analysis is low. The OTR Group report cited by Willcocks, indicates that only 30% of companies surveyed applied any structured risk analysis in evaluating projects (320). Studies at ICL suggest that in general, people are uncomfortable with the concept of risk, and tend to veer towards undue optimism or pessimism (321). Griffiths and Willcocks state that "overall, it appears that risk factors are not considered a main variable in projects, and consequently they are massively underplayed and under-assessed (322). Clearly therefore, there is considerable room for improvement in this aspect of investment appraisal.

The explanation for this could reside in a study by Pike and Ho, which revealed the following as the main barriers to risk assessment, in their order of significance: (323)

- Managerial understanding of techniques
- Obtaining input estimates
- Time involvement
- Cost justification techniques
- Human/organisational resistance
- Trade-off between risk and return
- Understanding of output and analysis

The forces which have given rise to the need for a new paradigm in IT investment appraisal have had a similar impact on risk assessment. The increased importance of organisational and human resource considerations, a turbulent business environment, rapid and unpredictable change, and the emergence of quality and service as key performance criteria have added a new dimension of complexity in assessing risk, even though this is undoubtedly offset to some degree by cheaper and more reliable hardware. The pervasiveness of IT in organisational structures, giving rise as it does to a move from financial criteria towards those of a more subjective and qualitative nature, has created a similar requirement in the area of risk assessment.

It seems clear therefore that a formalised evaluation of risk must be a factor in the investment appraisal process.

10.2 Risk issues in the appraisal process

Recent studies by Willcocks and Margetts, Bessant, Ward and Earl have identified the following shortcomings in IT projects (324).

- lack of a unified strategic framework
- lack of organisational adaptation to complement technological change
- IT supplier problems with hype preceding delivery
- poor management of change leading to inappropriate organisational and project structures, processes and culture
- over emphasis on the 'technical fix'
- a misguided belief in technology leading to unwanted products or services
- lack of skills to support implementation
- lack of exploration of a wide range of options, resulting in the exclusion of lower technology alternatives

10.3 Specific Risk Categories:

It would seem likely that any structured approach to risk assessment would require some form of risk classification. Such classifications exist in abundance, many in the form of Cost/Risk matrices, such as that from the CSC Index Group shown in Fig. 10.1. (325). These matrices have the advantage of simplifying complex issues, but this strength also represents their weakness, in that such simplicity could be misleading.

Fig. 10.1 **CSC Index Cost/Risk Matrix**

Comfort **Low Cost / Low Risk**	**Confidence** **High Cost / Low Risk**
Caution **Low Cost / High Risk**	**Confusion** **High Cost / High Risk**

To develop an approach to risk which can contribute to the overall investment framework of Chapter 12, a more comprehensive classification, which recognises the unique challenges posed by today's business environment, is proposed. These categories can be summarised under four headings, Organisational, Project, Staff, and External.

10.3.1 Organisation Risks

Strength of alignment with business objectives

The risk of the project not aligning with business objectives is potentially one of the most serious. The rate of business and technological change which characterises today's business environment makes this consideration at once both more important and more difficult. A further complication arises from the capacity of an IT investment to act as a catalyst for business change (see Chapter 6), and conversely, to act as an impediment if it turns out to embed outdated practices in software or hardware (see Chapter 8). To address this category of risk effectively, it appears clear that top management commitment is called for. Factors adding to the risk would be imprecise or contradictory objectives, a turbulent external environment resulting in the need for frequent revisions of objectives, or inadequate processes for linking business and IT strategies (see Chapter 6).

Culture

The risk cultures of organisations vary considerably. For example, the attitude to risk taking in a government department, to take one extreme, is likely to be considerably different to that in a high technology company seeking to enter or even create new markets. The government department, or a similar type organisation, is more likely to set a high premium on a careful, well documented approach to risk, using well known and reliable suppliers, applying a minimum of innovation. Such an organisation would set a high premium on following prescribed guidelines and procedures, against which any subsequent failures or shortcomings in the project would be evaluated. By way of contrast, the organisation on the opposite end of the spectrum would see risk taking as an essential element of competitive advantage. This may result in purchasing relatively untried hardware or software, perhaps from financially unstable suppliers, or specifying ambitious implementation deadlines. The organisational culture is such that risks such as these are deemed to be acceptable.

Organisational preparedness

The organisational impact of many systems can be considerable. Earl has shown how such impact can be reflected in changes in job definition, power structures, career prospects, the degree of job security, departmental influence or ownership of data (326). Any one or combination of these factors could have an impact on the success of the project, and as IT becomes increasingly embedded in core business processes, such considerations assume greater importance (327). There is much research to show that organisations vary widely in the extent of their preparedness for such outcomes (328). For example a long-established, hierarchical, task-oriented organisation may find it much more difficult to adapt compared to an organisation which is modern and flexible, with a flat organisational structure (329).

Management support

The degree of management support for an investment in IT may be crucial, and as IT plays an increasingly important role in organisational redesign, such support assumes added significance (330). The extent of this support varies considerably with the type of application. For instance, such support for projects related to business reengineering and Executive Information Systems is crucial, but will be less important for infrastructure investments such as the implementation of a new network.

10.3.2 Project Risks

Project management skills

Project management skills are crucial for a successful implementation, yet appear to be often overlooked, or confused with general development staff capabilities. The author has experienced a project where the staff were all high-calibre and well motivated. Yet the project ran both behind time and over budget, due to a fall-down in project management. The assumption was that with staff of such a calibre, strong project management skills were not required. In the author's experience, skilled developers often lack the capacity and willingness to engage in project management and testing.

Size and duration

Cash *et al* have demonstrated how the exposure to risk can be said to vary markedly with the size and duration of the project - the bigger the project, and the longer it takes to complete, the bigger the *risk*, and Ward states this to be "almost self evident" (331). Sometimes this can be offset by dividing it into sub-sections, outsourcing some of the components (although outsourcing can itself be a risk, see Chapter 9) or by hedging the risk by entering into a co-operative development arrangement. As Brooks has shown in his seminal work *The Mythical Man-Month*, the laws of complexity apply to the number of components or individuals associated in a project (332). That is, the difficulties and problems increase exponentially with the number of factors (see below).

An accurate estimation of size and duration calls for a realistic appreciation of development staff output. This is often postulated on the "best case" principle at the planning stage, i.e. each member of the development team has his or her contribution determined on the basis of what he or she *is capable of producing* in a given day. What is capable of being produced, and what actually is produced, can vary widely however. A major study by Charles Portman of ICL showed that such productivity was in fact about half what it should have been in theory (333). "Machine downtime, higher priority unrelated short jobs, meetings, paperwork, other company business, sickness, personal time etc. accounted for the rest".

Complexity

As with size and duration, the risk varies closely with the level of complexity (334). Ward states that "complexity can arise in both the business and the technology and is usually compounded by the number of business functions which need the new system, and the number of other systems with which it must be integrated or interfaced (335). Complexity can often be a function of an attempt to reduce costs. The author has experience of a company which sought to implement Executive Information System functionality through the use of existing applications such as spreadsheets and e-mail, with a Visual Basic user interface. The project cost a lot less than a standard EIS, but built-in complexity stemming from version control and integration issues created many unanticipated problems.

Functional uncertainty

As the objective of applications moves from cost saving and automation of existing tasks to the broader meeting of corporate objectives, the risk of functional or definitional uncertainty inevitably increases. This could be reflected in the imprecise or incomplete definition of the business problem, and/or the proposed business solution. Systems that fail to fully address the business problem are now commonplace (336). This may stem from an inability of the system users to define requirements accurately, or an inability of the analysts to accurately assess those requirements. The operating system, programming language(s), and development tools all have a bearing on technical uncertainty. The level of risk is closely related to the level of maturity of these components (see Chapter 9).

Hardware and vendor related risk

As organisational and business issues assume increased importance, hardware dependence has shown a commensurate decline. Risk associated with the hardware component of an investment relate to meeting delivery date, performance, reliability, financial strength of supplier, potential redirection of supplier strategy (e.g. a move from proprietary to open systems) during the life of the project, the newness of the technology (337). A move to a client/server environment may pose particular risks in terms of capacity, the number of interfaces between different platforms, the number of protocols used, the number of hardware and software vendors, and performance planning (338).

Capacity for testing

It is obvious that the degree of testing capable of being applied for a new application will have a major impact on its eventual success, but this capability can vary significantly. The main determinants are time constraints and the extent to which existing functions are being directly replaced by the new system. The introduction of an invoicing/debtors system would represent an example of this. In this instance it is likely that test output can be compared to pre-determined values, possibly even in the context of a parallel run, whereby the new and old systems run in parallel, allowing for comprehensive, real-life testing (339).

As the automation of existing manual or part-manual applications declines in relative terms (see Chapters 3 and 7) such clear-cut opportunities are becoming less frequent however. As IT becomes increasingly applied to the redesign of existing work practices, such opportunities for testing and trialling become reduced. Most process redesign initiatives, must of their nature, be implemented in a real-time environment (see Chapter 8). This increases technological, organisational, and cultural risk.

New Technology

Griffiths and Hochstrasser state that "working with new technology always introduces heightened levels of risk (340). They apply special significance to the tendency of time pressures resulting in experimentation passing into fully-fledged implementation before the completion of an adequate testing phase, leading to sub-optimal results. They point out that this development often leads to higher than anticipated maintenance costs. New technology will in addition, of its nature, not be as tested or robust as the older variety.

10.3.3 Staff Risks

User commitment

The level of user commitment is a key element in determining the success, and hence the level of risk, of most projects. Textbooks abound with examples of applications which failed due to user opposition or lack of support (341). These can be influenced by factors such as the general quality of industrial relations, job security, standards of IT training, user-friendliness of the new system, and the degree of user involvement in design or selection.

User capabilities

Increasingly, the success of applications depends on the capabilities of users to exploit them. This is a direct consequence of the rush towards end-user computing, which in turn derive from the characteristics of today's business environment, which have been described several times in this research. Even with the support of the users, inadequate training, experience, or the implementation of an application too complex for the calibre of the user, will increase the risk of failure.

Staff stability

A high turnover of staff, particularly development staff, increases the level of risk in a project. This posed a severe problem in the 1970s and early 1980s, but appears to have declined as a problem in recent years. Nonetheless, the staff most likely to be lured away are likely to be the best - thus posing the greatest risk to the project. The capacity to recruit new staff should be a factor in the risk assessment, but induction time into a development team can be an important consideration.

10.3.4 External environment

Competitive action

This is likely to represent the most important external risk for most organisations. This is born out in a 1990 survey of 80 US, UK, Australian and New Zealand companies, which showed that 61% of respondents used "response to competitive systems" as an investment criterion, and that this percentage was growing (342). Action taken by a competitor may have direct impact on an IT project. For instance, an insurance company may be planning to introduce a claims processing system which will provide greater internal efficiencies and information. This project could be jeopardised by a competitor introducing a system which provides enhanced service levels to the customer. This competitive development could result in the project being abandoned and replaced by one incorporating matching levels of service.

Government legislation

New legislation, or changes to existing legislation, can impact the risk profile of a project. The potential impact varies according to the industry. A good example relates to the deregulation of the aircraft industry, which had far-reaching ramifications for every airline, affecting IT by way of generating requirements for new applications, changes to existing ones, and greater emphasis on cost control and payback. Government initiatives can have even more impact in the public sector. The author has personal experience of how a change in the building planning regulations required changes to an application which had been purchased, and was in the process of being implemented.

The economy

Economic performance can impact the financial well-being of a company in a variety of ways, and therefore its capacity to allocate project resources. The economy can also influence the competitive environment, either favourably or unfavourably, with possible impact on project requirements or resources.

10.4 Additional considerations

History

Willcocks and Margetts attribute considerable significance to the organisational history of previous projects in the risk assessment process, and cite a number of case studies where this had an impact (343). Experience gathered from projects can be applied effectively to the risk reduction process in new projects. The suspicion must remain however that, given the continuing scale and frequency of failure, the adoption of such lessons still leaves a lot to be desired. This is underlined by a case history undertaken by the author in an agrochemical company. Despite having invested close to £500,000 in an earlier system which failed to deliver the expected benefits, the company repeated the same mistakes to an uncanny degree. The main lessons learned - that purchasing 'the right system' will not in itself guarantee the successful deployment of IT, and the need for management involvement at all stages of the process - were ignored the second time around. This suggests while history can indeed by valuable, it may not attract the attention that it merits from management.

10.5 Refining the Risk Analysis

The analysis derived from the foregoing framework can be refined by the application of sensitivity and probability analysis techniques. Whereas these will be most appropriate where financial values or other forms of quantitative criteria are involved, they may be suitable for wider application. While these techniques can be applied manually, they are only practicable with the use of computerised simulation tools

Summary

The high level of risk attached to IT investments, particularly when related to correspondingly high levels of expenditure, merits inclusion as a separate perspective in the overall evaluation framework. The inadequate levels of risk assessment currently prevailing suggest the need for a structured approach to the problem. The framework proposed in this chapter seeks to incorporate the key issues, while addressing the current inhibitors in the area. Evaluating risk in terms of the organisation, project, staff and the external environment should ensure consistency between applications, as well as a reasonable level of completeness. Ideally, this should lead over time to an 'organisational memory', which could provide a valuable resource when undertaking risk assessment for future projects. The sub categories proposed are not seen as prescriptive, rather as thought starters, which may vary between organisations, and even between projects.

The application of Sensitivity and Probability Analyses is recommended, in that the potentially disproportionate impact of some elements may be highlighted, while the identification of the 'worst case scenario' will also be enhanced. The value of such techniques, restricted as they are to quantitative criteria, has declined however, as the impact of IT becomes embedded in most organisational processes.

Chapter 11. Scoring and Weighting, and Other Criteria

11.1 Introduction

The criteria reviewed in the previous five chapters are complex and wide-ranging in their potential impact on IT investments. A number of other criteria, less complex and narrower in scope, were identified in the course of the review of current approaches to investment appraisal (Chapter 5). These are reviewed below.

11.1 Weighting and Scoring

Clearly, the relative importance of the perspectives described in the previous five chapters will vary between organisations. For instance, a company with severe cashflow problems is likely to assign a high weighting to *payback* (particularly direct cash savings), and to assign a low weighting to *architecture.* By way of contrast, a financially strong company, seeking to position itself for future expansion, would be likely to reverse these weightings. Therefore the component elements of each perspective need to be assigned relative priorities in order for potential projects to be evaluated. For the exercise to be realistic therefore, a set of weightings reflecting corporate values and priorities seems called for.

While the weighted perspectives may provide a comprehensive coverage of the factors upon which successful investments are based, in themselves they do not provide a framework which identifies the respective merits of projects, or a baseline on which acceptance or rejection can be decided. A scoring system or other set of criteria must be assigned to each proposal to evaluate the extent to which the proposed investment matches the weighted criteria for each perspective. Such a scoring system, using the multiple attribute decision model, was developed by Berliner and Brimson in 1988, and subsequently adapted for *Information Economics* (344).

Many of the leading theorist and practitioners in this field take the need for a weighting and scoring mechanism virtually for granted (345). The *Information Economics* approach, for example, gives little or no theoretical justification for the use of these factors. In the case of the weighting principle, the authors simply state that the key evaluation criteria "are weighted" before assigning scores. Considerably more attention is paid to scoring, although for the most part this attention relates to scoring techniques for individual components of the exercise rather than a justification *per se.* The authors say that "projects can be ordered or ranked by their (weighted) scores, providing a more balanced assessment of a truer economic value to the enterprise. This provides a consistent yardstick or measurement for establishing logical investment priorities..." (346).

When scoring on Strategic Match, for example, the authors provide five possible scoring alternatives, ranging from 0 to 5. These are outlined in Fig 11.1:

Fig. 11.1 Scoring Example for Strategic Match (*Information Economics*)

Score	Criterion
0	The project has NO direct or indirect relationship to the achievement of stated corporate (or departmental) strategic goals
1	The project has no direct or indirect relationship to such goals, but will achieve improved operational efficiencies
2	The project has no direct or indirect relationship to such goals, but the project is a prerequisite system (precursor) to another system that achieves a portion of a corporate strategic goal
3	The project has no direct or indirect relationship to such goals, but the project is a prerequisite system (precursor) to another system that achieves a corporate strategic goal
4	The project directly achieves a portion of a stated corporate strategic goal
5	The project directly achieves a stated corporate strategic goal

The scores range from zero (having no linkage to strategic goals) to 5 (having a direct linkage). In order to apply the scoring, the authors assume a corporate strategy is in place, and that "it is clearly stated and understood by participants in the scoring process". They add that participants in the process "must work towards a consensus of understanding". An essential element of the *Information Economics* scoring technique is that it be performed by experts in the relevant area. Staying with Strategic Match, the participants are seen as being from the business, as distinct from the technical domain. "Those scoring Strategic Match are those who understand the nuances of the business

thrust".
Remenyi, *et al* provide a spreadsheet program to assign weights and scores to a range of prescribed variables, which the authors say are linked to *Information Economics* principles, but again do not provide a theoretical foundation for the weighting and scoring concepts (347). The authors state that "such techniques are popular, and are therefore used extensively in business". The inference from these and others in the field is that the need for such techniques is self-evident (348). Based on research undertaken in the UK insurance industry, Serafeimidis and Smithson came to see scoring and weighting as essential to a balanced investment approach, and provide strong support for the theory. "Conflicts of interest often emerge within as well as between stakeholder groups which can affect evaluation, much of which is subjective, based on stakeholder value judgements. It also means examining the mechanisms of representation of different interests, the institutional means by which divergent evaluations can be discussed". They also emphasise the importance of the evaluation process to take on board the "fundamental values of the organisation" and the need for "assessments by managers, IS professionals and users at all stages" of the process. A scoring and weighting approach is then applied to identify a "benefits profile" from the planned investment (349).

Weighting and scoring also form a central element of Ward's portfolio approach but sees them as being applicable only to critical success factors (CSFs) (350). While acknowledging their limitations, including the possibility that 'he who shouts loudest will obtain priority' he sees some form of weighting and scoring as essential in the evaluation process. The difficulty with assigning different criteria for financial performance and CSFs however is the risk of comparing 'apples with oranges', as identified by Hares and Royle (see below). Another researcher/practitioner to apply scoring and weighting principles in investment appraisal (this time in the context of assessing intangible costs and benefits) is Vaid-Raizada, but again, these are simply taken for granted as part of the proposed methodology, no justification is provided (351). Money *et al* provide a comprehensive framework for evaluating intangible benefits using conjoint measurement and self-stated utility which in effect are firms of weighting and scorings (352).

The application of weighting and scoring is not confined to academics and commentators. Many organisations use such techniques as part of their normal evaluation process, such as the Prudential Insurance (353) a European Port Authority (354) and the Swiss airline company Swissair (355). The Swissair method appears to work satisfactorily, even with what would appear to be a rigid set of weights which remains unchanging for all investments over a protracted period of time. The weighting and scoring mechanism defines projects as belonging to one of three approved priority classes, priority one, which should be started first when ever possible, priority two, which are of medium strategic and commercial significance, and priority three which are of less importance than the others.

11.1.1 Limitations of weighting and scoring

However, the use of weights and scores is not without its critics. Strassman is in strong disagreement. He bases his criticism of *Information Economics* (an appellation which he refuses to acknowledge, referring to it instead as P.B.T. after the initials of the authors) on the technique used to calculate return on investment element. In particular he sees as "implausible" the recommended scoring whereby a score of 1 is allocated to an investment returning a rate of 1% to 299%, with every additional 200% adding 1 to the score. He argues that to assign the same score to a range spanning 200 percentage points, given that average returns are in the range of 8.6% to 25.6% (Strassman's figures), renders such scoring meaningless. This criticism is somewhat unreasonable, in that it selects out the one dimension (ROI) which is most convincing in dealing with "hard" figures, and least convincing when handled by a score. In the really difficult aspects of IT investment like linking technical and business requirements, so-called "hard" figures are very difficult to apply, and here the *Information Economics* tools are much more appropriate. Strassman does not mention these aspects however. In addition, he neglects to mention that the figures he quotes are examples only. The authors of *Information Economics* allow for individual practitioners to apply their own variations, and there is no intrinsic requirement for the scores or the ROI ranges to be as allocated in the example.

Hares and Royle go to considerable length to demonstrate that the only meaningful method of evaluation is to apply a financial value to all potential benefits from a proposal, in the process rejecting the weighting/scoring technique "..in order to construct a structured method for IA (investment appraisal) all business activities should be measured in money terms, enabling a single financial model to be developed. The usage of ... scorings and weightings for the units of business measure (is) rejected. If one did use the non-financial scorings/weightings approach it would result in two parts to the model for investing - the monetary and the non-monetary. Being based on different paradigms, the two measures could not be judged as to their relative significance. Investment decisions would be correspondingly based on inconsistent information - a dangerous situation" (356).

The authors warm to their task by examining a worked example provided by Berliner and Brimson (see Fig. 11.2). They see considerable significance in the fact that the direct financial benefits of £1,080,000 are assigned a score lower than the intangible benefits. They see the inadequacies of the approach not only between the lack of a common basis for comparing direct and intangible benefits, but what they see as three separate units of measure for the intangibles. They conclude that this is "an artificial situation".

Fig. 11.2 Limitations of Weighting and Scoring

Investment benefits	Score (0-10)	Weight (0-10)	Risk (0-1)	Total
Direct Benefits				
*** Labour saving (930k)**	7	0.6	0.9	3.78
*** Stock reduction (150k)**	1	0.6	0.9	0.54
Intangible benefits				
*** Improved Quality**	2	0.05	0.5	0.05
*** Quicker delivery**	8	0.2	1	1.6
*** Greater reliability**	2	0.05	0.5	0.05
Net value				6.02

Similarly they believe the allocation of weights in column three should be "treated with grave suspicion", because the intangible benefits are assigned greater weight than those delivering direct financial payback. As was demonstrated in Chapter 7, there is no reason why a company should not see intangible benefits as more important than those providing direct payback, and indeed the authors in other sections of this book go to considerable lengths to demonstrate the inadequacies of techniques which emphasise financial payback! The authors contrast this approach with one which has finance as the only criterion. This they claim provides a unit of common measure, without which comparisons are meaningless.

This is quite simply incorrect. There is no reason why a finical payback cannot be assigned a value to a company in the same way as one which cannot be measured. For instance, an investment in IT might result in a company winning a prestigious industry award. It is not unreasonable to suggest that company management could state the value of this achievement in terms of a cash equivalent. They might, for example, say "we would as soon win this award as be presented with a cheque for £50,000". Management is faced with such trade-offs every day, and the logic of it is that a financial payback can be evaluated or scored in terms of contribution to corporate objectives in the same way as other possible benefits. In any event, as Willcocks, Keen, Strassman and others have shown, so-called "hard" benefits often camouflage the fact that the precise mathematics are based on figures (such as "anticipated increase in sales volume") which are just educated guesses (357).

This is borne out by some of the examples Hares and Royle cite to support their argument. They claim for instance that 'speed of service' and 'product presentation' "can be converted into monetary terms in their ability to maintain sales, sell more, charge a higher price, or create new business". Financial values can be assigned by calculating factors such as the number of additional sales and multiplying this by the average value/profit of sale, or by multiplying the increased price by sales volume. In doing this, they fall neatly into the trap identified by Keen, Strassman and Willcocks and referred to in the previous paragraph.

Finally, a worked example of the method as applied to an IT investment appraisal exercise in a harbour authority is provided. The exercise is followed through in great detail, and the result defined in financial equivalents is presented, and ends with the statement "the quantification technique proved its worth". They go on to ask however, astonishingly, in the light of their earlier claims, "can the figures presented have been (sic) finessed even further? It is becoming clear that the answer is yes - the pure monetary measure was not adequate". Later on they state "But the financial figures did not show the true extent to which business objectives were being achieved. *The financial figures were therefore weighted and re-expressed as a score*". (italics mine).

Further comment seems unnecessary. As Hares and Royle found, some issues simply cannot be expressed in financial terms. This would apply to most of the issues coming within the strategic alignment, architecture and risk *perspectives* (such as company reputation, investments in enabling technologies such as backbone networks, or the potential impact of trade union opposition), and attempts to assign financial values to them become increasingly implausible and unsustainable. There is nonetheless some support for this approach in the literature. One of the strongest is provided by the University of Manchester Institute of Science and Technology (UMIST), which boldly claims "Work done at UMIST in 1985 showed for the first time, that there should be no such thing as an intangible benefit. Since that time, no one has described a benefit that could not be redefined into quantifiable terms" (358). The somewhat brash nature of this claim is underlined in the following paragraph when the authors state that "the nature of intangible benefits is such that they do not appear in the department where the investment is made, but occur elsewhere in the company". Such unsupported sweeping statements undermine one's confidence in the ability to directly value intangible benefits, and when one analyses what the author terms "intangible" one finds that they are in fact quite tangible (e.g. reduced rework, reduced stock levels).

Despite its imperfections, a set of weights and scores, developed (as suggested by Parker and Benson) "by communication and consensus between the business and technology domains of the enterprise" and facilitated by the active involvement of the Chief Executive Officer, appears a very realistic way to evaluate IT investments. This does not seek to minimise the necessity to tie down intangible benefits in financial terms wherever possible (see Chapter 7), but attempting to quantify all the impacts of an IT investment in financial terms alone is not supported by the evidence. Therefore a weighting and scoring approach is proposed.

11.2 Issues of Investment Type

11.2.1 Should different appraisal methods be applied to different investment types?

Many researchers and practitioners have proposed methodologies or approaches particularly applicable to different forms of investment. Weill and Henderson, for instance, provide methods specifically for evaluating infrastructure or architecture investments, while the DataPro Group do the same for strategic investments (359). While the authors see their methodologies as particularly suited for the relevant forms of investment, they do not claim that each investment type requires its own methodology. Others take the view that attempts to evaluate all investment types with the same technique are futile.

CSC Index Group

The CSC Index group propose that systems can be evaluated under four classifications (360).

Systems where the cost is low and the possibility of achieving the benefits high are placed in the *comfort* cell. More expensive systems with a high degree of certainty of achieving benefits are placed in the *confidence* cell. Where the cost and benefits certainty are both low, the system should be placed in the *caution* cell. Finally, where system have a high cost and uncertain value they should be placed in the *confusion* cell.

Guidelines are provided for each category. For instance, systems in the *confidence* cell are seen as appropriate for conventional finance-based criteria, for those in the *caution* cell prototypes and experimentation are recommended, while business reengineering is seen as typical of a *confusion* category investment, for which there is little by way of methodological support.

Farbey, Land and Targett

Farbey *et al* propose a series of parameters through which potential investments may be evaluated, what they call matching the project with an evaluation method (361).

The role of the evaluation

This determines whether the evaluation is taking place early or late in the project, or whether the evaluation is being carried out at the tactical or strategic level.

Environment

This refers to the "decision-making/cultural environment" of the project, and is seen to have four sub-components:

- The decision process: whether it is standard or *ad hoc*
- The types of benefits, tangible or intangible
- The importance of numbers - will an attempt be made to attach numbers to all benefits and costs
- The cost of the approach: Whether simple and cheap methods can be used or whether they must be expensive and comprehensive

The system

This addresses whether the system is a specific application or whether is provides an infrastructure, or whether it is core (at the heart of the company's production and delivery chain) or supporting (financial, documentation).

Organisational characteristics

This takes in another two variables, the first being the industry, whether it is stable or turbulent, the second is the leadership role of the company (i.e. market position, or whether it is a leader or a follower).

Cause and effect relationships

This is based on the extent to which the anticipated benefits are directly related to the system being evaluated, and the degree of uncertainty with which the impact of the new system can be predicted.

The authors seek to relate these criteria to a set of potential evaluation techniques, such as cost/benefit analysis, payback, information economics, return on management (ROM) etc. In some instances they suggest that several techniques can be used for the one project. They acknowledge that their proposal is a speculation, "derived by trial and error from the factors which seem most relevant to the choice of evaluation method. It has, at present, no theoretical foundations, and is not based on any tested rationale".

Ballantine, Galliers and Powell

The authors devote a paper to assessing the respective merits of standard and non-standard approaches to investment appraisal (362). They agree initially, quoting Lumby, that "using the same yardstick or measure of value to decide among alternative investments, is one that has dominated the investment decision making process within organisations for years" (363). They go on to claim that "as a result, organisations have...focused primarily on the use of financially-oriented techniques of appraisal", and conclude this point by demonstrating the limits of finance-oriented techniques (see also Chapter 4). The assumption that a standard technique is synonymous with a finance-oriented one crops up on several occasions in this paper. No support for this assertion is provided, other than anecdotal evidence that companies using standard approaches also use finance-oriented ones. This does not mean that because companies are using single-measure techniques, that these have of necessity to be finance-oriented ones. The primary objective of this research is to develop a framework which can be standardised, yet will take into account all issues relevant to IT investment appraisal.

The authors also claim that the use of a standardised approach may be the result of "a lack of knowledge of the process of appraisal/evaluation, or of the project itself, or to a lack of knowledge regarding the tools available for appraisal/evaluation by the evaluators themselves". This may well be true, but it does little to invalidate the merits of a standardised approach. Just because many organisations use the wrong standard approach for the wrong reasons, does not mean that a standard approach can never be the most appropriate.

The authors argue that standard procedures can be manipulated "in such a manner that the results are fruitless". This is undoubtedly true, but there seems no reason, other than lack of familiarity, why non-standard techniques cannot also be manipulated. In fact, in a sense they provide additional scope for manipulation, in that they allow the possibility of selecting the most appropriate non-standard technique for getting the result wanted - to produce the 'right' figures.

Another argument is to the effect that firms allocate "a budget in respect of IT/IS investments, and an additional budget for other capital investments. In this case the argument for similarity of treatment between IT/IS and other capital investments is weakened". This is true, but does not have meaning when comparing potential <u>IT</u> investments - the purpose of this review.

The authors provide strong evidence to show that organisations are driven by multiple goals, (citing Parrow, Ezzamel and Hart), and as such "the argument for similarity of appraisal.... is no longer a sustainable one". They quote these sources further to support the thesis that "official goals are not, in themselves, adequate for understanding organisational behaviour. Operative goals may be inconsistent with official goals, in some cases they may even subvert official goals" (364). They conclude by claiming that "given that organisations are likely to hold multiple goals, the argument for similarity of appraisal and evaluation....is no longer a sustainable one". The authors position assumes that a standard methodology cannot accommodate a variety of organisational goals. There is no obvious basis for making this claim, and the current research will seek to demonstrate that a standard methodology can in fact accommodate multiple goals. If the point is taken that many organisations have both multiple and conflicting goals, and the authors cite convincing research to support this, then indeed a standardised approach will not prove fruitful. Then again, it is difficult to envisage how any approach, either standard or non-standard, can guarantee an effective appraisal if organisational goals are contradictory.

Whilst the authors come down in favour of a non-standardised approach, they do offer the following supporting the principle of standardisation:

- It provides a consistent "benchmark of performance through which competing projects, irrespective of their nature, are capable of comparison"
- It ensures that the resource allocation process within a firm is "both perceived to be, and is in practice, impartial in that it does not discriminate against any one type of investment to the exclusion of the other".
- It facilitates a comparison of the potential and actual returns achieved.
- Alternatives identified in the decision situation can only be compared when they have the same measure or "yardstick of value" and are hence, capable of comparison

Earl's Four-Way Framework

The very basis for Michael Earl's investment framework is that different forms of investment require different approaches (365). Whereas the author provides a framework, and a detailed prescription for its application, he does not address the theoretical underpinnings. He does say however in conclusion that it is based on three premises:

1. Different IT uses have different attributes
2. In reality, many investment and strategic decisions are not made as finance theory prescribes
3. IT appraisal should not differ fundamentally from investment decisions in general

According to the four way framework, different forms of investment have different objectives, and such objectives are better evaluated through specific techniques. For example if *productivity and performance* are being pursued, efficiency and effectiveness are likely to be the goals, and financial appraisal methods are most appropriate.

Consolidation

Even though many leading practitioners in the field adopt a standard approach to investment appraisal (Strassman, Remenyi, Hares and Royle), and others such as the *Information Economic* approach have achieved widespread use, some commentators continue to argue for a multi-standard approach. As has been seen earlier, much of the opposition to the single standard stems from the assumption that such approaches are usually finance-oriented - and therefore inadequate (see Chapter 4). However, there is no logical reason why this has to be, and those techniques referred to earlier in this paragraph underline that the single standard not only does not have to be finance-oriented, but that it can be, and has been, successfully applied in practice.

This still leaves open the question of whether the standard approach is the best. Once the "finance only" misrepresentation has been removed, there do not seem to be strong grounds remaining to reject the standardisation. Farbey *et al* demonstrate a range of different investment types, and how issues related to the company and the business environment can impact the investment process. However, there is no reason why a standard approach cannot address these issues. The five perspectives proposed in chapters 6 to 10 fully incorporate all the elements referred to by the authors, as does the *Information Economics* method, and indeed others as well - all using a standard methodology. Other reservations expressed by Ballantine *et al* have been addressed above, and do not appear to provide a sustainable case for a non-standardised approach.

There are a large number of factors however to support standardisation, and the following have been admitted by Ballantine *et al* (366).

- It provides a consistent platform on which competing projects can be evaluated, one would have though an essential requirement for investment fund allocation.
- It provides transparent evidence of fairness in resource allocation
- It facilitates a comparison of actual results achieved between projects

The following additional factors have been identified by the author in the course of consultancy assignments and as part of the current research:

- Management are reluctant to apply unfamiliar techniques, even when a standard method is applied. This has been identified by Hochstrasser and Griffiths, and also became clear in the course of implementing the framework developed as part of this research (367). For the most part, management tended to lose interest and commitment once unfamiliar concepts were introduced. Clearly, the practice of introducing different techniques for different investments would generate an even greater adverse reaction. (See Part III).
- The possibility of building a store of 'corporate wisdom' for application in later

appraisals is reduced when non-standard techniques are applied.

For these reasons, a standard framework capable of general application was proposed.

11.3 Sensitivity Analysis

Sensitivity analysis, a technique applied to optimise the prospects of a successful investment, is frequently used in the investment process, and has been described as "the most common technique for measuring risks and robustness" (368). Sensitivity analysis in this context is defined by Vause and Woodward as "an assessment of which factors have the greatest impact on its success" (369), or as "a tool for evaluating specific factors to be closely monitored" by Parker and Benson (370). The latter propose growth, return on investment and revenue protection as typical subjects for sensitivity analysis, but recommend it only for large projects, seeing it as inappropriate for "the typical information systems nomination call". Typically, sensitivity analysis involves assigning a number of possible outcomes to the key variables, and recalculating the investment appraisal for each of the assigned values. This may identify vulnerabilities not evident by way of the standard calculations.

Whereas formal sensitivity analysis techniques are easily understood and equally easy to apply (all that is required is the assignation of a series of different values to key variables, and a recalculation of the appraisal), it does suffer from drawback. Hares and Royle have identified the following:

- It can deal with only one variable at a time, whereas in reality nothing varies in isolation, so "one technique is not sufficient to model accurately the problem and the technique breaks down". The authors see this as an serious limitation to formal sensitivity analysis techniques.
- It does not show how likely the outcomes are, that is, the probability.
- It does not readily show how flexibility can be applied to minimise risks or exploit opportunities

While there is no doubt that projects are more susceptible to the impact of some factors than others, the formal application of sensitivity analysis techniques, mainly through its limitation to one factor at a time, does suffer from serious drawbacks. Nonetheless, the objective of the technique, identifying key factors and their potential impact under different conditions, is a valid one. As demonstrated in Chapter 12, this consideration will be incorporated in a *de facto* way in the proposed methodology, but not by way of formal sensitivity analysis.

11.4 Probability analysis

Sensitivity Analysis represents an improvement on a single range of forecast values, but does not address the issue of the degree of certainty with which the various forecasts can be made.

The forecast values for most components within a project are likely to vary from the eventual actual values. It is possible to forecast many with a considerable degree of accuracy (for example, hardware costs), while forecasts for other elements (typically, software development costs) are often subject to significant variation.

It is possible therefore to assign degrees of certainty to ranges of values for individual components. In other words, to assign their probability distribution. For example, a new order processing system is planned to give rise to overtime savings in the despatch office. The most likely range of savings might be in the $10,000 to $12,000 range. This could be assigned a probability of 0.6. The next most likely range would be 5,000 to 10,000, and would be assigned a probability of 0.3, and the least likely outcome would be in the range of 12,000 to 15,000, which would be assigned a probability of 0.1. Therefore the most likely range would be twice as likely to occur as the next most likely, which in turn would be three times as likely to occur as the least likely.

Representing this probability distribution in terms of NPV IRR and Payback Period would be helpful in assessing the likely viability of the project. The Monte Carlo Simulation, developed by Hertz in the 1960s, is a commonly-used technique for this purpose (371). This performs complex, repetitive calculations, hundreds or even thousands of times, which taken together provide a risk profile of the proposed investment. The term Monte Carlo Simulation derives from the element of chance which forms the basis for the exercise. Any project evaluation involves forecasting values based on various assumptions. Certain assumptions may be made with a reasonable degree of certainty, while others may be subject to a wide range of possible outcomes. The purpose of simulation is to try to reproduce the randomness inherent in this concept, thus giving a "most likely picture" to emerge in a real-life situation.

This is achieved by having the system generate random values for selected components. Although random, these values reflect weightings specified by the user. This is impor-

tant, because while in a real-life situation various unpredictable outcomes may occur, some possible outcomes are clearly more likely to occur than others.
After Simulation has been run, it is possible to make judgements such as "there is a 90% chance that the Internal Rate of Return (IRR) will be above 15%, and a less than 1% chance that it will be below 5%". Used in conjunction with the "what-if" facilities, it provides a useful additional tool for evaluating the risk factor involved.

The simulation generates random numbers within the probability ranges defined. It then recalculates the model repeatedly, each time arriving at a different possible outcome (often defined in terms of NPV, IRR, or Payback Period).

To revert to the example above, for every ten random numbers generated, the system will generate 6 for the range 10/12,000, 3 in the range 5/10,000, and 1 in the range 12/15,000. The full model will be recalculated each time. The requirement of randomness is met, while simultaneously the weighting ensures that the requirements of probability are also met. Thus a large number of recalculations based on this methodology provides the closest approximation to a real-life situation, and will represent the most comprehensive picture of the range of possible outcomes, and their likelihood.

Even though the simulation will be performed repeatedly, the final picture produced will consolidate all of the possible outcomes into a single graphical representation (histogram) which will elucidate the risk profile for the project. Only those elements identified through Sensitivity Analysis as likely to have a significant bearing on the outcome of the project should undergo this simulation.

The Monte Carlo simulation is an advance on basic sensitivity techniques.

- It forces consideration of all the major uncertain variables
- It allows these variables to vary independently
- It forces quantification of the risk and variability of outcomes
- The results indicate how likely the expected, best and worst outcome is likely to be

It does have a drawback in relation to the difficulty of interpreting the result. For example, is it better to select a project with a high spread of results (high risk) but with a higher expected value, or a low spread of results (low risk) but with a lower expected value?

The concept of probability on balance then must be seen as a valid requirement for project appraisal. However, given the very limited extent of the techniques currently being applied to IT investment appraisal, and the tendency of management to avoid sophistication, it was felt that a sophisticated technique such as Monte Carlo simulation was unlikely to be applied in a conventional organisational setting. Subsequent fieldwork (see Chapter 13) confirmed that such an interpretation was correct. Given that the acceptability of the proposed framework in such a setting has been defined as a key objective of the research, this must be seen as an important consideration.

11.5 Investment Scope

The four phase evolution of IT has been demonstrated in Chapter 3. This showed that by Phase III, IT had become part of the fabric of business, underpinning most if not all business processes. It also traced the growth of end user computing and the extent to which networking and communications had grown in relative terms to computer hardware and software. Systems were also shown to have become highly integrated, with data and resources being shared between different applications. These developments have lead to a situation whereby it has become difficult to define where and when a particular investment ends, and indeed what elements of expenditure relate to that investment

A further complication stems from the increasing importance of communications in relation to computers. As Bob L. Martin, former CIO of Wal-Mart's International Division says, "I see fewer investments ahead for us in computing and more in communications. By this I mean we are shifting our emphasis away from processing systems ... and towards technologies that are more integrated with the work of our associates" (372).

It was seen in Chapter 5 that several commentators (Weill, Norton and Nolan, Farbey) saw the time factor as an important consideration in IT appraisal. However, this was for the most part in the context of infrastructure or architecture investment, for which payback was long-term and less clearly defined. Keen, Willcocks and Strassman take the time factor into consideration, and make the point that the time frame of benefits might be uncertain (373). Weill and Curley identified a more profound issue in relation to the development of a methodology for investment appraisal (374). They showed the limitations of the commonly-applied 'once-off' approach to investment appraisal, and emphasised that they saw investment as a process, not a single event. Although presented in the specific context of risk assessment, this point is also raised by Hay and Williamson, who emphasise that once-off assessments are inadequate in that they fail to take into account the significant changes that can occur during the course of IT projects, and the dynamic aspects of risk management (375). Although the literature does not show this to be a major concern (see Fig. 11.1) it does raise an important issue in the context of the development of an evaluation framework.

Essentially, the question is: if a system grows and evolves during its lifetime, adding new and unanticipated functionality, spreading into different areas of the business, and providing core data for other unrelated applications (such as end-user computing), how can it be evaluated in an effective way? There is no simple answer.

It is probably more meaningful to address the problem from the opposite perspective, i.e., given that there is no perfect solution, does this mean that the attempt to apply a structured framework should be abandoned? It would appear self-evident that a framework that addresses all factors other than this must be better than a totally non-structured approach, *particularly if this limitation is kept in mind during the evaluation process.* This is borne out by the research. A.T. Kearney, Willcocks, and Hares and Royle all show that the lack of an appraisal framework has contributed to poor payback, and/or that the use of a structured approach improves payback (376). In fact Hares and Royle emphasise that "the major cause of all current problems with valuation is therefore judged to be the absence of a comprehensive structured method of investment opportunity identification an investment appraisal" (377). The position taken therefore is that while this factor to an extent undermines the value of structured calculations, the limitations are outweighed by the proven gains from a structured approach, particularly when they are explicitly recognised during the course of the appraisal exercise.

11.6 Timing

The timing of the investment may be an important element in determining its success or failure. Cash *et al* state "get there too early, as Chemical Bank did with its electronic home banking product in the early 1980s...and you can create a real fiasco. Get there too late, as the regional airlines and hundreds of drug wholesalers did, and you may lose your life" (378). Keen also emphasises the potential impact that timing can have on the success of the project (379). On balance however it was felt that explicitly incorporating this factor into the framework would give rise to unjustified complexity, and in any case it would appear that it can be adequately accommodated as part of the Risk perspective.

Summary

Some of the criteria reviewed in this chapter on the evidence seem to form an essential part of the evaluation process, others less so. Weighting seems the most clear-cut. Factors in the evaluation process (e.g. cash-flow, quality) which may be vitally important for one organisation may be of little importance to another. It follows that a mechanism must be found to represent these priorities in the evaluation process, and a form of weighting is proposed as the most appropriate one. The case for scoring is less obvious, with many commentators identifying limitations of one kind or another. However, to paraphrase Churchill on democracy, despite its limitations, the evidence shows that it represents the best way to assess a project's potential contribution to organisational objectives.

The necessity for sensitivity and probability analyses is less clear-cut, yet, as has been shown, these concepts can have a significant impact on the outcome of an evaluation. They are thus incorporated (indirectly, in the case of sensitivity analysis) in the first fieldwork applications of the framework. Issues surrounding investment scope and timing, as raised by many commentators and researchers, represent legitimate areas of concern. However, there appears to be virtually no capacity to formally incorporate these criteria without introducing unacceptable levels of complexity. As the minimisation of undue complexity is a key objective of the research (part of the need for *acceptability*), these criteria have not been explicitly incorporated in the framework, but, as described earlier, their ramifications can in many cases be indirectly addressed.

Chapter 12. Consolidation of Concepts

12.1 Introduction

Before attempting to develop a framework based on the material developed in Chapter 5, it seemed appropriate to revisit the objectives of the research as defined in Chapter 2.

The objectives of the research are to develop a framework for IT investment appraisal appropriate for present conditions, and to test the acceptability and suitability of the framework in a range of organisational settings.

Given the reluctance of management to apply formalised investment appraisal techniques (see Chapter 1, 2.3), the requirement of *acceptability* assumed considerable importance, and demanded that the framework not be over-burdened with complexities or be too time-consuming to implement. On the other hand, the requirement of *suitability* in a range of organisational settings called for a considerable degree of comprehensiveness and flexibility. The approach taken was to integrate those concepts identified as essential or important in Chapter 5, and to discard or incorporate in other forms the remainder.

The result is shown in Table: 12.1

Table 12.1

Concept	Classification
Strategic Alignment	Essential
Payback	Essential
Architecture	Essential
Risk	Essential
Business Redesign	Essential
Weighting	Important
Scoring	Essential
Probability	Important
Sensitivity Analysis	Somewhat Important
Investment Scope	Somewhat Important

12.2 Selecting the criteria

Based on this tabulation, five perspectives through which the potential investment must be evaluated were identified. These were:

- Strategic alignment
- Payback
- Process redesign
- Architecture
- Risk

These would be *weighted* (an essential criterion) by appropriate management of the participating organisations to reflect their relative importance to that organisation, as illustrated in Table 12.2.

Table 12.2

Perspective	Weight
Strategic alignment	-
Payback	-
Architecture	-
Risk	-
Business Redesign	-
TOTAL	100

The extent to which the proposed system(s) would meet its objectives would be accomplished by appropriate management *scoring* it/them against a set of sub-components for each perspective. Finally, a probability factor related to the probability of achieving the scores would be allocated.

Keeping form-filling to a minimum was also seen as essential in the light of the requirement for simplicity, particularly as management would be providing most of the material. Preliminary discussions with participating management indicated that time-consuming tasks were unlikely to be completed. This lead to the decision to distill a *small number of key determinants* from each of the chosen perspectives, and standardise on these for each appraisal exercise. For the first exercise this took the following form:

12.2.1 Strategic Alignment

Category Selection Rationale

(a) *The importance of IT to the organisation*: The extent to which organisational performance is dependent on IT is a key determinant of the Strategic Alignment weighting. The 'strategic grid' developed by Cash, McFarlan and McKenny is helpful in establishing an appropriate position (380). When IT is a *support* activity it means it plays no significant part in present or future plans, and therefore represents a low priority. When IT is crucial for current operations, but is not, or is not planned to be, of strategic importance, it is classed as *factory*. IT is placed in the *strategic* quadrant when it has had longstanding significance in the success of the organisation, and where the future of the firm is likely to depend increasingly on IT. The difference between companies in the *strategic* quadrant on those classed as *turnaround* is that in the latter case, while IT may not have been significant in the past, it is liable to show a dramatic increase in importance in the future. Such firms are characteristics by leadership in IT matters from the board and the fostering of an IT culture.

(b) *Liquidity*: Only in the event of a company being in a liquid position is *strategic alignment* likely to achieve a high weighting. Even turnaround companies, highly dependent on IT for future success, will have to bias their weightings in favour of *payback* or *risk* if cash is in short supply.

(c) *Market turbulence*: Turbulence and unpredictability are now routine features of today's business environment. However, the extent to which organisations are impacted by this turbulence varies. For instance, the "market" for a hospital's services is likely to be more stable than that of a firm engaged in selling leading edge technology products. The greater the turbulence and instability, the more difficult it is to achieve and maintain *strategic alignment*. This should be reflected in the weighting for this perspective, but will be dependent on the importance of IT to the organisation, as described in (a) above.

Table 12.3 **Strategic Alignment Sub-components**

Sub-component	Weight
Importance of IT	-
Liquidity	-
Market turbulence	-

12.2.2 Payback

Category Selection Rationale

(a) *Liquidity*: In the event of a company being in an illiquid position, or where policy calls for immediate improvement in profit figures (for example to fend off a take-over) direct financial benefits will assume added importance, giving rise to a higher weighting for this perspective. The converse also holds true.

(b) *Price sensitivity*: The price sensitivity of a company's products may vary considerably between markets. A high weighting will be applied if the company is in a price-sensitive industry, such as grocery or petrol retailing.

(c) *Market threat*: By way of contrast, if a company's *market*, as distinct from its competitive positioning, is under threat, *payback* will assume reduced significance, as short term benefit will eventually prove ineffectual if the market itself is under threat. Steel or shipbuilding would be representative industries, and in such conditions the relative weightings for *strategic alignment* and *reengineering* would be increased.

(d) *End-user computing:* The extent to which end-user computing is adopted varies widely between organisations (381). On the basis that end-user developed applications will not be strategic or infrastructural, financial payback should be afforded greater importance. High usage should therefore be reflected in a relatively high weighting.

Table 12.4 **Payback Sub-components**

Sub-component	Weight
Return on investment	-
Price sensitivity	-
Market threat	-
End-user computing	-

12.2.3 Process Redesign

Category Selection Rationale

(a) *Current business environment*: As described earlier, driven largely by developments in technology, organisational structures are undergoing radical change. Flexibility, rapid decision making, and customer responsiveness are but some of the qualities called for to meet these new demands. Whereas few organisations are immune to such pressures, the degree of pressure does vary (382). Hardware or software producers could be said to represent one extreme, while government departments would represent the other. The extent to which these pressures apply would be a key determinant in the weighting applied to *reengineering*.

(b) *Competitive trends*: Medium to long term competitive trends may demand radical organisational restructuring. For instance in Ireland the associated banks, although currently earning high profits, face unprecedented competitive pressures over the next few years. Largely due to EU competition policy, foreign banks, and Irish and non-Irish building societies will be able to offer direct competition. This has resulted in reengineering-style initiatives now being afforded high priority in these banks, and where such trends apply to a firm, *reengineering* should be given a high weight.

(c) *Redesign opportunities*: In terms of suitability for reengineering, operational processes will vary widely between organisations, and even within the one organisation. Among the key indicators identified by Hammer & Champy are high inventory levels, extensive re-entry of information, a high proportion of checking and control to value added work, a high incidence of complexity and "special cases" (383). A preponderance of these dysfunctions suggest that *reengineering* should be weighted highly.

(d) *Management commitment:* The commitment of senior management is an absolute prerequisite for successful reengineering (384). If this commitment is missing, reengineering does not represent an attractive proposition, and should be allocated a low weighting.

Table 12.5 **Process Redesign Sub-components**

Sub-component	Weight
Current business environment	-
Competitive trends	-
Redesign opportunities	-
Management commitment	-

12.2.4 Architecture

Category Selection Rationale

(a) *Importance of IT to the organisation*: As with *strategic alignment*, the importance of IT to the organisation will directly impact the weighting for architecture. The McFarlane McKenny grid is again useful in determining this. In firms where dependence on IT is high, the architecture represents a key business driver and success factor. The concept can be refined to take into account the likely *future* dependence on IT.

(b) *Mergers, take-overs, strategic alliances*: Although apparently in decline since the late 1980s, the majority of companies would still seem at least to be mentioned as subjects for merger or take-overs. Strategic alliances, whereby companies (quite possibly competitors in the normal course of events) partake in joint ventures for a limited purpose represent an alternative course. The IBM/Apple alliance on the Power PC would be representative of this. In such instances the architecture assumes major importance, as inter-company workings are self-evidently facilitated by open, flexible architectures.

(c) *Operational links with suppliers or customers*: There is a growing trend towards companies integrating their production, supply and sales activities - the so-called 'virtual corporation' (385). Such initiatives can be greatly facilitated or hindered by participating firms' IT infrastructures. WalMart and McKesson are celebrated success stories, but even on a more humble level the infrastructure can be significant (386). A review of the author's consultancy notes identified a GM motor dealer which had to effectively sideline an expensive mini-based infrastructure which failed to provide adequate linkage with GM operations.

(d) *Reengineering enabler*: As has been seen earlier, an appropriate IT architecture is a vital determinant for successful reengineering initiatives. If *reengineering* is a high priority, then so also should *architecture*.

Table. 12.6 **Architecture Sub-components**

Sub-component	Weight
Dependence on IT	-
Risk culture	-
Organisational risk	-
Supplier reliability	-

12.2.5 Risk

Category Selection Rationale

(a) *Level of dependence on IT*: Organisational dependence on IT has been discussed earlier, and can vary significantly between organisations. The greater the extent of this dependence , the greater the weighting assigned to risk.

(b) *Risk culture of organisation*: Some organisations are conservative and risk-averse, others have a culture which encourages bold initiatives and risk-taking. The latter would assign a low weighting to the Risk factor. An added element in this context is the extent to which risk management and assessment processes are in place, the greater the extent, the lower the weighting.

(c) *Customer impact risk:* Some companies in sensitive industries such as banking could incur serious negative customer reaction as a result of systems failure, either by way of failure to provide needed services on time, or embarrassment arising from incorrect information. By way of contrast, companies facing the risk of collapse can take a very cavalier attitude to risk, on the basis that they have nothing to lose. This was the case with the heavy industry company taking part in this research.

(d) *Exposure to supplier reliability:* Some risk attaches to almost any supplier of IT solutions today, as the horrendous losses incurred by even the likes of IBM and Digital underline. Exposure to supplier viability is reduced in mluti-vendor sites, and increased in single-vendor sites, with some vendors representing a greater risk than others.

Table 12.7 Risk Sub-components

Sub-component	Weight
Significance of IT	-
Mergers/take-overs	-
Operational links	-
Reengineering enabler	-

12.3 Scoring and probability

As referred to earlier, the proposed scoring mechanism envisages the assignment of a number of scoring categories to each perspective. In order to maintain consistency, the proposed elements for each *perspective* were proposed as static criteria - that is, they were to be maintained for each appraisal exercise. The score was assigned on the basis of the extent to which the proposed system met the objectives of each category on a range of 0 to 10.

The issue of probability was also included, on the basis of assigning a probability factor (0.0 to 1.0) on the basis of the likelihood of the estimated score being achieved. This was then applied to the score, giving an adjusted score. Thus an element achieving a very high score on the basis of the potential impact could be outweighed by an element with a lower score, but for which the probability of achievement was higher.

12.3.1 Strategic Alignment

Sub-component Selection Rationale

(a) *Business enabler*: The extent to which the proposal addressed organisational objectives by *enabling* new ways of doing business. As was shown earlier, making old organisational structures operate more efficiently no longer suffices in itself - *effectiveness* is now the key requirement.

(b) *Cultural/educational*: The extent to which the proposal supported the cultural and educational objectives of the organisation. As organisations undergo radical restructuring, these requirements assume added significance. Does the system undermine important elements of corporate culture?. For example, an interactive multimedia based customer information system may, while providing many operational advantages, be out of character in an organisation which prides itself on personalised customer service.

(c) *Rapid adaptation:* Could it adapt quickly to the rapid changes demanded by today's business environment?. Irrespective of how good a system may be, its value will be diluted if it lacks the capability to adapt quickly and cheaply to the changes the business will inevitably undergo in today's turbulent environment.

(d) *Development/implementation timeframe:* The greater the length taken to develop an/or implement the system, the greater the chances are that it will deviate from corporate objectives.

(e) *Clarity of relationships*: The clarity and cohesiveness of business plans and objectives vary considerably between organisations. It is difficult to assign a high score when a lack of clarity exists. This will be compounded when the objectives of the system are also unclear or inadequately specified.

Table 12.8: **Strategic Alignment Scoring Sub-components**

Sub-component	Score	Probability	Adj. Score
Business enabler			
Cultural/educational			
Rapid adaptation			
Timeframe			
Relationship clarity			
Total Adj. Score			

12.3.2 Payback

Sub-component Selection Rationale

(a) *Cost savings:* Cost savings are easily identified, and include staff reductions, less overtime, lower inventory carrying costs, better quality (less rework and warranty).

(b) *Revenue generation:* This can result from new product introduction, product enhancement or differentiation, faster billing, better bad debt control.

(c) *Management support:* Benefits can be created by way of, traditional management support, through systems which facilitate strategy and the management of performance, and strategic management monitoring.

(d) *Competitive positioning:* Payback can be created through sales and marketing support systems which enhance a company's position in the marketplace (payback), or which help to lock in customers through the provision of IT-enables services (payback).

Table 12.9 **Payback Scoring Sub-components**

Sub-component	Score	Probability	Adj. Score
Cost savings			
Revenue generation			
Management support			
Competitive positioning			
Total Adjusted Score			

12.3.3 Process Redesign

Sub-component Selection Rationale

(a) *Process impact:* The extent to which a proposal complemented the transition to a *process*, as distinct from *task*-based organisation represented probably the most important feature in scoring the *reengineering perspective*. Conventional corporate systems are generally divided into sub-systems which reflect departmental boundaries such as Sales, Order Processing, Manufacturing, and Accounting. Whereas these are usually integrated, they do tend to reinforce departmental divisions, thereby undermining attempts to reengineer along process lines. By way of contrast, distributed databases, based on client server technology, provide an open and flexible access to corporate data, facilitating adaptable work practices and the transition to *process* based operational modes.

(b) *Simultaneous processing:* One of the primary causes of delayed response times is caused by sequential as distinct from simultaneous handling of transactions. Good examples are applications for bank loans or insurance cover. Typically, only one person works on the application at a time, whereas a high proportion of the tasks could in fact be worked on simultaneously, greatly reducing processing time. High scores should be allocated to facilitating IT investments such as workflow systems.

(c) *Expert/rule based systems*: Business process redesign frequently results in a realignment from low to relatively higher skilled (and higher value) tasks (387). However, bottlenecks may be caused by a lack of suitably skilled personnel. This can be addressed by way of expert or rule-based systems. As Hammer and Champy put it "this fact has profound implications for the ways in which we can structure work" (388).

(d) *Devolved decision support:* The capacity to make on-the-spot decisions is a key facilitator of reengineering. Systems with strong decision support capability, allied to an integrated corporate data repository, provide this functionality. Modern executive information systems (EIS), whose usage is now spreading down to lower organisational levels, would represent an example of this.

Table 12.10 **Process Redesign scoring sub-components**

Sub-component	Score	Probability	Adj. Score
Process impact			
Simultaneous processing			
Expert based systems			
Decision support			
Total Adjusted Score			

12.3.4 Architecture

Sub-component Selection Rationale

(a) *Consistency:* How consistent are the hardware, software, programming language and data bases of the proposed system with the organisation's infrastructure. The degree of consistency, which probably represented the most important element in *architecture*, determined the score. A refinement could relate to *infrastructure planning*, whereby plans are in place to replace or significantly upgrade the existing facilities. In such instances, a balance could be struck between current and planned requirements.

(b) *Enabler of other applications*: Some systems while enhancing the infrastructure on their own right may also add by way of enabling or improving other systems. To revert to the example of the point-of-sale system, this could, by way of capturing additional data, or existing data earlier, improve the quality of current sales and order processing systems, or enable them to develop additional functionality. Such functionality was seen as a scoring plus.

(c) *Mandatory component*: The proposed system may have been a mandatory component of the planned *architecture*. For example, the system under review (perhaps a revised General Ledger application) could be dependent on the provision of a new corporate relational database. This database may also represent a mandatory component of *architecture* planning, and as such should be allocated a score over and above that relating to the system's other impact on *architecture*.

(d) *Reliability of vendor:* This issue assumed greater importance for *architecture* than for any other *perspective*. Failure of a vendor, particularly where the vendor provided key elements of the *architecture*, would be likely to cause considerable business disruption.

Table 12.11 Architecture Scoring Sub-components

Sub-component	Score	Probability	Adj. Score
Consistency			
Other applications			
Mandatory			
Vendor reliability			
Total Adjusted Score			

12.3.5 Risk

Sub-component Selection Rationale

(a) *Scale*: This was seen as probably the most important risk issue. While the failure of a small project might represented an acceptable risk, a large one could resulting in potentially crippling operational or financial impact. Scale is dependent on the strategic impact of the system. Some systems while large, may have limited operational impact (e.g. a human resources application), exposing the organisation to lower risk than a smaller one affecting core activities.

(b) *Technical risk*: There is an almost limitless array of technical risk., with uncertainty in definition of requirements, development problems, hardware and software performance, and systems integration being the most common. As with so many other issues, the rate of technological change plays a key role here - today's success story could be on tomorrow's scrap heap. The trend towards multi-vendor sites, while reducing the risk of a "big bang" failure, adds a new dimension by way of added complexity.

(c) *Effectiveness of risk management*: The exposure to risk can be greatly reduced by way of risk management (389). Examples would be prototyping, staged development and implementation, the possibility of a fallback position (e.g. can the previous system be reintroduced?), the possibility of parallel running, and the use of sub-contractors and/or temporary staff. A *high* score reflects *poor* anticipated risk management, and vice versa.

(d) *Top management support:* Willcocks and others have shown that the success of IT projects is closely linked with the commitment of top management to seeing it through (390). Whereas this varies according to the project, increasingly, success depends on human and organisational considerations, for which top management commitment is essential. A *high* score reflects *a low level* of top management support, and vice versa.

Table 12.12 Risk scoring sub-components

Sub-component	Score	Probability	Adj. Score
Scale			
Technical risk			
Risk management			
Management support			
Total Adjusted Score			

Note: Risk scores are negatives. The higher the score, the greater the risk, and the total is subtracted from the scores under the other *perspectives.*

Summary

In summary therefore the kernel of the framework would be applied on the basis of an organisation's management team applying weightings, reflecting that organisation's priorities, to the five *perspectives*, Strategic Alignment, Payback, Architecture, Process Redesign, and Risk. The proposed system would be scored against criteria applicable to each of these *perspectives.* These scores would be adjusted to reflect the weightings assigned to the perspectives, and the probabilities of the scores being achieved. The total adjusted score would reflect the viability of the proposed investment. This obviously has most significance when ranking alternative proposals - that with the highest score representing the most attractive investment. However, the score can also be meaningful for single investments where a minimum score is set, ideally based on corporate wisdom accumulated over a number of investment appraisal exercises.

Summary of Part II and Introduction to Part III

The review of the literature and the methods applied by practitioners identified a wide range of criteria being applied, of which a number predominated. Each of the criteria identified was critically evaluated in the light of the research objectives, and a number were deemed essential for the framework. One criterion, reengineering, or business process redesign, was of particular interest, in that while barely featuring in any of the methodologies reviewed, it was nonetheless deemed essential for the proposed framework.

The review of the criteria could be summarised as follows:

Strategic Alignment, "a state of harmony between the goals and activities of a business and the computer systems that support them" was seen as essential due to the extent to which IT has become a key enabler of all business processes, and the rate of technological and business change.

Payback needed little justification, in that it bordered on self-evident that the possibility of achieving direct benefits should be a factor when evaluating IT investments. The various kinds of benefit were analysed, and an appendix provided a mechanism for establishing firmer business value for so-called 'intangible' benefits. Given the trend from manufacturing to services, the relative decline in the importance of direct benefits was highlighted, nonetheless, the importance of performing some form of benefits measurement was stressed.

Process Redesign introduced a perspective which was almost totally missing from other approaches identified in the literature. The inclusion was justified by establishing that today's business organisational structures remain based on theories originally formulated over 200 years ago, theories which emphasise a hierarchical form of control. This was shown to be unsuited to the requirements of today's business environment, which must respond to calls for short product development and life cycles, tougher competition, volatility, and a rapid increase in the incidence of mergers/demergers, acquisitions/divestitures. This can often be accomplished by a form of radical business process redesign, usually underpinned by IT, and frequently driven by IT capabilities. The widespread application of process redesign concepts, and the unique role of IT, suggested that potential IT investments should be evaluated under this *perspective*

The IT architecture, which could loosely be described as a company's computers, software, databases, telecommunications, programming languages and operating systems and the relevant standards for each of these entities, was shown have become much more complex in recent years, with the likelihood of this complexity increasing. The main issues contributing to this complexity were reviewed, and it was established that neglecting the architectural ramifications of IT proposals could seriously undermine their business value.

Risk is another *perspective* whose incorporation in the framework should have been almost self-evident, yet it was shown that comparatively few organisations formally apply risk evaluation techniques. This was despite the high level of failures and disappointing outcomes associated with IT investments. It seems clear therefore that a formalised evaluation of risk must be a factor in the investment appraisal process. The types of risk were reviewed, with special emphasis on the relative increase in importance of human and organisational considerations.

Having reviewed the five primary *perspectives*, other issues were then evaluated. Weighting and scoring were deemed essential in establishing the degree of acceptability of proposals, and there was compelling evidence to support the inclusion of some form of probability analysis. Other factors, such as longitude (how does one establish a cut-off date for a system?) and scope (with the growth of distributed and end-user computing, most systems tend to grow almost organically beyond the original scope) were reviewed, but, on balance were deemed inappropriate for inclusion as discrete elements of the framework.

Consolidating these criteria into a practicable framework was then addressed. It was proposed to view every investment through the five primary *perspectives*, Strategic Alignment, Payback, Architecture, Process Redesign, and Risk. Given that the relative importance of these criteria would vary between organisations, it was deemed essential that management apply a weighting to each. The proposed system would then be scored against each of the criteria, with the score adjusted to reflect the respective weightings. A form of scoring based on management's business and technical judgement was deemed to be the only practical way of evaluating an investment's potential value. Attempts by researchers to assign monetary values to all potential benefits were assessed, but found to be unrealistic. Finally, the issue of probability was addressed by assigning a probability factor to each of the criteria, reflecting the degree of certainty with which the various scores were predictable.

A framework appropriate for field work research was therefore available and mapped onto a set of working papers for field application. A number of suitable organisations was identified, and, applying the research methodology identified in Chapter 2, the field testing commenced.

Part III Field Research

Chapter 13.
Field and case application of framework, review of findings

13.1 Introduction

An essential objective of the research was that the proposed framework be applicable by, and acceptable to, general management as part of their normal operations, ("to test the acceptability and suitability of the framework in a range of organisational settings" - Chapter 2).
The participating organisations had to be selected carefully. The first issue was size. A very large organisation would have given rise to problems in that the decision making process was likely to be slower, and the possibility of bringing together the relevant managers would be more difficult. On the other hand, a very small organisation (say, fewer than 50 staff) could present difficulties in terms of the size of the investment, the likelihood of decisions being made in an informal manner by the chief executive, and a general unsuitability for the kind of structured research required. The organisations chosen therefore had staff numbers in the range of 100 to 500, with volume turnover reflecting these staffing levels.

To test the general applicability of the framework, the organisations chosen differed widely, from a local authority at one extreme, to an advanced high-technology telecommunications company at the other. As indicated in Chapter 2, where the field research indicated changes or additions to the framework, these were incorporated and tested in the next organisation, and if successful, incorporated into subsequent trials.

The framework underwent a fair degree of change in the course of the fieldwork, but none of the changes were fundamental. All major changes occurred as a result of fieldwork in the first two organisations. Subsequent amendments and enhancements were of a more cosmetic/utilitarian nature, resulting in the framework remaining largely consistent from Organisation 3 onwards. To illustrate the operation of the framework in live settings, two full worked examples have been included in Appendices V and VII. These examples had a direct bearing on the systems selected by the companies concerned.

The field application of the framework was supplemented by two further initiatives.

The first of these was a survey undertaken among Ireland's leading companies. This survey sought to put the fieldwork application of the framework in perspective by focusing on background issues such as IT budget control (i.e. who controls the budget?), degree of satisfaction with existing investments, investment appraisal methods being used, and the extent of management understanding of key investment appraisal issues.

The second took the form of Executive Briefing Days undertaken by the National Institute for Management Technology (NIMT). These were workshops involving a small group of managers from individual companies who were briefed on the framework and worked through its possible application in their organisations. This forum provided tremendous opportunities for the interchange of ideas and for practical applications of the frmaework.

The results of the field research are detailed below.

13.2 Organisation 1

13.2.1 Background

The first organisation participating in the research, which took place between February and April 1995 inclusive, was a local authority. In terms of size, degree of computer literacy, and overall operational practices, the selected body would be representative of an average Irish local authority, and a small one in the UK. The County Manager made clear that profound changes were on the way for local authorities, with performance-related measures due to be put in place, with a consequent ending of many of the old comfortable attitudes to work and the 'customer'. In fact, with the likely privatizing of many of the local authority's services, there was now a likelihood of compulsory redundancies within a few years - something unimaginable a few years ago. IT was seen as an essential element in meeting these new challenges. IT investment appraisal therefore assumed a correspondingly high importance, particularly in the light of the limited success of previous initiatives. The objective of the exercise was to evaluate the feasibility of a proposed investment in a Building Planning system for the Planning Dept., amounting in total to approximately £250,000.

13.2.2 Research Chronology

An initial meeting was held with the County Manager, the Finance Manager, the

Planning Manager and the IT Manager. The County Manager stated that he was unhappy with the return the authority was getting from what had been substantial investment in IT in recent years, and while he was not criticising anyone in particular, he felt that the justification procedures used heretofore were inadequate. He now wanted a different approach to be applied before substantial amounts of additional funds were allocated to the Building Planning system.

There was general agreement that there had not been an adequate return from the investment in IT, but much of this meeting was taken up with explanations for this failure, and points scoring between the participants. Nonetheless, there was full acceptance of the need to apply a new approach, and in broad terms, all participants felt the proposed method looked promising. However, once the workings of the methodology began to be explained, it became clear that the participants were very focused on issues of costs and direct benefits. A major knowledge gap applied with the other four *perspectives,* to a greater or lesser degree. It was felt that the best approach was to provide each participant with a written rationale of the principles underlying the framework, and, upon being reviewed, a second meeting would take place. The written rationale is contained in Appendix II.

This meeting took place within two weeks. It was clear that the County Manager and the Planning Manager had a very limited understanding of the document, while the Finance and IT Managers had achieved a reasonably good grasp of the issues. It was decided to press ahead with the exercise, notwithstanding the disparity in understanding. The view taken was to the effect that full interest and therefore participation would not otherwise be achieved.

13.2.3 Weightings

The first task was to assign weightings to the five perspectives. This showed up an immediate limitation of the approach, in that several of the sub-components provided were deemed to be unsuitable or not fully relevant to a local authority. These were as follows:

- Liquidity and market turbulence
- Competitive positioning
- Competitive trends
- Mergers/takeovers

This development somewhat undermined the credibility of the exercise, and a diminution of enthusiasm became apparent. A number of alternative sub-components were suggested as being more appropriate for a local authority. For instance, "market turbulence" was adapted to represent the likely medium term initiatives by central government to cut costs and make local authorities more responsive to the "customers", and more responsible for generating their own income. Weightings were assigned to each *perspective* and are summarised in Fig. 13.1, but there was a general lack of conviction about the process.

Fig. 13.1 **Organisation 1: Summary of Weightings**

Perspective	Weight
Strategic Alignment	20
Payback	30
Process Redesign	20
Architecture	10
Risk	20

13.2.4 Scoring

While the revised sub-components provided for scoring were more appropriate, there remained a perception of their being less than fully relevant to a local authority. Perhaps because of this, one meeting, lasting approximately two hours, was sufficient to complete the exercise. It was found that participants were reluctant to contribute to aspects that they did not understand. For instance the IT Manager completed almost all of the scoring for the *Architecture* perspective, whilst he had little contribution to make to *Strategic Alignment.*

The following is a summary of the scores assigned, adjusted by the relevant weights:

Fig. 13.2 **Organisation 1: Summary of Scores Adjusted by Weights**

Perspective	Weight	Score	Adj. Score
Strategic Alignment	20	7	140
Payback	30	5	150
Architecture	10	3	30
Process Redesign	20	4	80
Risk	20	(5)	(100)
Total	100		300

There was no enthusiasm for applying probability factors. The reasons given were that it was "unnecessary" or "too detailed". Possibly the real cause was tiredness, or a feeling that enough had been done, which in reality was hardly the case. No probability factors were therefore allocated, and the calculations proceeded without them.

13.2.5 Summary and Conclusions

The weightings were somewhat predictable, and were assigned without much disagreement. Payback was, as expected, assigned the highest weight, based largely on the need for existing staff to undertake an anticipated major increase in planning applications over the coming years. It was equally predictable that Architecture would be assigned the lowest weight, partly on the basis that few of the participants really understood its significance. The weight of 20 to Process Redesign was somewhat disappointing, in that it was quite obvious from everything that was said that the authority would have to radically redesign its processes over the coming years. Again, the low score could mainly be attributed to a general lack of understanding.

An interesting feature of the exercise was the surprise that the adjusted score was, at 300, so low. The county council team had assumed that the proposed system would make an excellent investment. It is possible to infer from this that the potential benefits of the system envisaged by the management team prior to undertaking the exercise outweighed perceived unfavorable factors, or, more likely, that these unfavorable factors were not identified by them until the framework was applied. However, even when the scores were revisited, only slight adjustment were proposed to the original set of scores, and were so insignificant that the originals were maintained.

The practice of scoring Risk negatively and subtracting the figure form the total gave rise to some confusion when the management team was assessing the scores. The negative scoring of Risk was subsequently revised when applying the framework for Organisation 3.

The proposed approach was outside the range of experience of the managers involved. Even the Finance and IT Managers, while having a much better grasp than the other two, nonetheless had difficulty in taking in many of the concepts. This problem was compounded by the demonstrable diminution of interest shown by the participants when challenged by new concepts.

A preponderance of emphasis was given to the *Payback* perspective during the evaluation process. This was possibly because it was best understood, even though much prior explanatory work had been done before the research exercise was adopted, but clearly the participants felt most comfortable when discussing tangible issues.

In the event of elements being seen as lacking in relevance to the organisation applying the methodology, the interest and commitment of the participants declines to a considerable degree.

Achieving a balance in the scoring is made difficult when the degree of interest in and/or knowledge of the perspectives varies between individual participants, with the committed/informed ones exercising disproportionate influence.

The concept of probability, especially in terms of numerical assignments, did not generate interest or commitment from the participants. This however could have derived in part from the lack of direct relevance of many of the elements forming the basis for the evaluation.

Once the concept of the framework was understood (to the extent that it was) the actual investment appraisal exercise was undertaken quite quickly. This was seen as a positive aspect by the participants. However, there must be a suspicion that the exercise was *too* fast, and that many contributions were made (or not made, as the case may be) to keep up the momentum.

A highly significant outcome of the exercise was the surprise felt by the participants that the proposed system achieved such a relatively low score, in view of their original perception that the system represented an excellent investment. This could be said to reflect the framework achieving its objectives, namely, providing new insights to the investment process. The value was somewhat diminished however by the lack of direct relevance of some of the framework's components in relation to local authority circumstances.

13.3 Organisation 2

13.3.1 Background

The second organisation is a medium-sized private company in the pharmaceuticals sector, which specialises in the manufacture and sale of products whose patents have lapsed. The company is reasonably profitable, but operates in a somewhat volatile environment, where competitive actions can have significant and immediate impact, and where distribution and marketing channels are constantly being revamped. The main driving forces for the company are cost control and the capacity to react quickly to competitive actions.

At the time of the exercise, which took place in the period April/June 1995, the company had made a decision to replace their existing order processing/accounting/stock control package, which handled all transaction processing. This package, based on proprietary Nixdorf hardware and software, had been very expensive, and despite major subsequent expenditure on modifications, had proved unsatisfactory. The company wanted to replace this with a more flexible client/server based solution which facilitated end-user computing and staff empowerment.

13.3.2 Research chronology

A number of preliminary meetings were held with the Finance Director and the IT Manager. It should be noted that the IT Manager was a relatively junior staff member, with all major IT decisions being made by the Finance Director. Both the IT Manager and Finance Director, conscious of the very poor returns from the existing system, expressed considerable interest in any framework which could help them make better IT investment decisions. Given that the proposed new system would impact every department, and would have ramifications for organisational culture and customer relations (totally new order processing and discounting), the author recommended that the evaluation team be extended to all senior management. This was at first resisted by the Finance Director, but he subsequently agreed.

The Managing Director, indicating the importance being applied to the exercise, called a special meeting of the board, and also included a representative from the firm's auditors. The author addressed this meeting, and explained the proposed framework in some detail. A long discussion followed, and it became clear that, while some managers had achieved a good grasp of the issues, others had not. It was agreed that, instead of the full team entering into the full exercise immediately, a form of 'half way house' questionnaire would be drawn up, with the objective of getting management to address the issues likely to arise in the course of the exercise, but in terms with which they would be familiar. This would have the added value of assisting those carrying out the exercise to focus on issues of concern.

While all of the management team returned the questionnaires, only the Finance Director, IT Manager and Operations Managers took a meaningful part in the investment appraisal exercise, the weighting section of which was completed in about two hours. The participants were reasonably comfortable with the five *perspectives* and their respective sub-components, which were still those which made up the original framework (Chapter 12) and subsequently applied in Organisation 1. Nonetheless, some of the sub-components (most notable End-user Computing) were found to be not fully relevant, while others, not directly covered in the taxonomy provided, but domain specific to the pharmaceutical sector (in particular issues relating to compliance testing) were suggested for inclusion. This suggestion had merit in that it would have made the exercise more relevant to the participants. However, the view taken at the time was to the effect that framework cohesion took precedence over relevance. This was based on the belief that changing sub-components for either the Weighting or Scoring exercises could result in the framework being manipulated to provide results desired by some participants, or could result in key sub-components being overlooked. (This restrictive approach was however discontinued in subsequent fieldwork - see Organisations 3, 4 and 5).

13.3.3 Weighting

The weightings were assigned in the course of a two hour meeting and are shown in summary form in Fig.13.3:

Fig. 13.3 Organisation 2: Summary of Weightings

Perspective	Weight
Strategic Alignment	10
Payback	35
Architecture	15
Process Redesign	5
Risk	25
Total	100

The weightings assigned accurately reflected management's priorities. Whether they best represented the company's medium to long term interests is another matter. Cost cutting and avoidance predictably dominated, with the new system being seen as having much cheaper maintenance costs, requiring less skilled (and therefore cheaper) staff to operate it, and, providing staff cost savings through the provision of faster information and decision support facilities. With all sections of the company strongly dependent on the system for transaction processing, and the memory of the earlier unsuccessful investment still strong, risk was understandably afforded a high weighting. As a result of the limitations imposed by the limited, closed architecture of the Nixdorf system, this *perspective* was afforded a relatively strong weighting.

The low weightings for strategic alignment and process redesign did not sit well with the challenges and opportunities the company faced. With a competitive business environment, unpredictable developments in the areas of links with suppliers and customers, the possibilities of customer lock-in or lock-out enabled by IT, and the company's existing 'command and control' organisational structure, strategic alignment and process redesign could reasonably be expected to have been afforded high weightings. The weightings they did receive underlined the somewhat limited understanding management had of the true impact of IT, still seeing it essentially in terms of transaction processing and cost savings.

13.3.4 Scoring

The scoring exercise went very smoothly, even though the IT Director, inexplicably, insisted that the supplier of the proposed system be included in the process. His contribution on scoring sub-components such as 'reliability and financial strength of supplier' was predictable! Nonetheless, the exercise was very useful, in that a comprehensive evaluation was performed, all involved played an active role, and many hitherto unidentified issues were revealed. Clearly however, strong-willed participants had much more impact on the scoring than the less assertive ones. This was seen as an issue of some importance, and in subsequent exercises was addressed by holding fewer group sessions, and more interviews with individual managers.

The final adjusted scores are tabulated in summary form below:

Fig 13.4 **Summary of Scores Adjusted by Weights**

Perspective	Weight	Score	Adj. Score
Strategic Alignment	10	8	80
Payback	35	6	210
Architecture	15	7	105
Process Redesign	5	5	25
Risk	25	(5)	(125)
Total	100	21	395

The scores presented a reasonably accurate assessment of the proposed system's investment potential. The flexibility provided by client/server was seen as a major contributor to the medium/long term alignment of the system with company objectives. Interestingly, the possibilities for direct benefits were much less than originally anticipated. This discovery was largely as a result of applying the end user computing benefits analysis approach identified on Appendix III. This exercise was undertaken by the author, and revealed that many of the projected 'benefits' would in fact provide little practical advantage to the company. Even though process redesign is greatly facilitated by the flexibility of client/server, this was nonetheless afforded a fairly low weight, in this writer's view due mainly to a lack of understanding of the issues. Despite the contributions of the supplier, risk was seen to be relatively high, given the scale of the project, the totally new technical environment, the organisational impact, and the general lack of IT skills in the company.

13.3.5 Summary and Conclusions

This exercise was much more effective than that for Organisation 1. While full management participation declined over time, in all there was a considerable commitment of time and a degree of collaboration which set clear ground rules for the appraisal process.

While management awareness of the full impact of IT improved considerably both as a result of the preparatory work and the exercise itself, this nonetheless remained inadequate, and to an extent limited the value of the exercise. Nonetheless, the exercise was seen as of considerable value by management, and the company plans to apply it for all future IT investments.

As with Organisation 1, providing a rigid set of pre-defined sub-components for each *perspective* was seen to have introduced a degree of artificiality into the weightings. Participants took the view 'why this and not that?' in many cases, and the emphasis on the need to maintain consistency appeared less convincing as time went on. This development introduced the requirement to experiment with assigning the weightings for each *perspective* on the basis of a review of the underlying principles relating to each *perspective*, and their impact on the company, rather than scoring sub-components separately. This approach was introduced in Organisation 3.

13.4 Organisation 3

13.4.1 Background

The research at Organisation 3 took place between June and December 1995. The company has continued to apply the framework as part of its project justification process since that time. Organisation 3 is a company operating in heavy industry, which has been downsized over a period of five years from 1,500 to 550 employees. At the commencement of the research it was state owned, but in the process of being privatised. Most of the existing management team had departed, and many of those remaining were on an uncertain footing. An executive chairman and chief executive (CEO) had been recruited in a consultancy capacity to oversee the final stages of the downsizing and cost-trimming prior to privatisation, at which stage their contracts would end. In the interim, they effectively ran the company, with the remaining management team largely in an order-taking role.

While cost-cutting was seen by the new management team (the chairman and CEO) as the number one priority, they also realised that some investment would be required to make the company competitive, and IT was one of the areas being considered. This stemmed in part from the poor state of the company's existing IT resources. Inflexible terminal-based legacy systems predominated, while PCs and distributed computing facilities were very limited. The IT Manager had been one of those made redundant, and his place had been taken by a very capable but inexperienced analyst/programmer. Prior to the on-site research being undertaken, an IT strategy for the company had been drawn up, which identified a number of areas indicating investment potential. The research project was seen by senior management as very much a 'working example'. They wanted it to be a useful contribution towards helping them to arrive at an effective investment decision, rather than as an academic exercise, although they did agree to fulfill the necessary research requirements.

13.4.2 Research chronology

Some initial exploratory meetings were held with the senior management team. The CEO had a negative attitude to IT, stating that in his experience it had provided minimal return on investment. He also opined that there was no mechanism for bridging the gulf between IT management and general management, and that decisions made on IT by general management were 'hit or miss'. Nonetheless, he was agreeable the try out the methodology on three proposed projects, one being a Rolling Mill Reporting System.

A fully worked implementation of the framework as applied to the Rolling Mill Reporting System is provided on Appendix V.

13.4.3 Weighting

As with earlier research attempts, it was found that only the Payback and Risk *perspectives* were understood in any detail by the management. Considerable time had to be spent in an education process relating to the other *perspectives*. This spanned a number of meetings, and the written material provided for the local authority case (Organisation 1) was accepted, but on the evidence of subsequent discussions, not adequately absorbed (if in fact it had been read at all). It was found that practical examples, ideally where they related to the company itself, were essential in elucidating the principles. After four meetings, and a number of informal telephone conversations, the senior managers accepted the validity of evaluating from the *perspectives* other than Payback and Risk, and were in a position to allocate weightings to all *perspectives*.

This approach clearly differed from the earlier research exercises, in that no sub-components for the five *perspectives* were provided. As indicated above, the weightings were based on discussion with senior management, written material, and relevant material from within the company. This resulted in management achieving a general understanding of each *perspective*, and weighting on the basis of this understanding.

This development was seen as a major advance on earlier applications of the framework, whereby individual sub-components formed the basis of the weightings.

Based on these criteria, the following weights were assigned:

Fig. 13.5 Organisation 3: Summary of Weightings

Perspective	Weight
Strategic Alignment	20
Payback	40
Architecture	10
Process Redesign	20
Risk	10
Total	100

Interpretation of weightings

These weightings should be seen as being relatively sophisticated, especially when related to the starting position. Whereas Payback was as anticipated given the highest weighting, this realistically reflected the company's position, and at 40, was significantly below what was originally proposed, when it was seen as being virtually the only meaningful criterion. Process Redesign, a concept which was virtually unknown at the outset of the exercise, was assigned a relatively respectable score of 20, reflecting the recognition of the need for flexibility in this highly competitive industry.

These weightings were to form the basis against which a number of potential projects were to be evaluated. The CEO let it be known to middle management, who would be assigning the scores, that this would not be just a "once-off" exercise, that each project would be continually re-evaluated on the same criteria, so that scores and values assigned to get projects approved would eventually be compared to actual results. It was observed that following this, line management became quite conservative in assessing benefits and risks.

13.4.4 Scoring

Again, the practice of providing pre-defined sub-components was amended, but not as drastically as with the weightings (in which no sub-components were provided). In an effort to achieve a degree of consistency, and a mechanism against which management could work with, sub-components were identified by outside consultants, the company's IT Manager, and the relevant line managers for each *perspective*. These were broadly based on the principles underlying the development of sub-components in previous research, but differed in that they were customised to the environment in which the investment were being made. These revised sub-components are treated in detail in the full worked example in Appendix V. As will be seen, some *perspectives*, (e.g. Risk) are very similar to the generic categories used in earlier research, while others were significantly customised.

When the exercise was completed, the scored evaluations were reviewed by senior management. Whereas there was no specific cut-off score for acceptance/rejection (some form of corporate history needed to be built up), the application under review scored reasonably well, and was approved for funding.

A summary of the weightings and adjusted scores ins shown on Fig. 13.6.

Fig. 13.6 Organisation 3: Summary of Scores Adjusted by Weights

Perspective	Weight	Score	Adj. Score
Strategic Alignment	20	7	140
Payback	40	9	360
Architecture	10	6	60
Process Redesign	20	7	140
Risk	10	5	50
Total	100	34	750

13.4.6 Some comments on the worked example

The worked example on Appendix V as well as being the first application of the framework in which the author did not participate, had some new characteristics:

- As will be seen, two *perspectives*, Payback and Process Redesign, were designated "Direct Benefits" and "Re-engineering" during the course of this exercise. This had no particular significance, other than that these terms were deemed by the consultant to be less open to misinterpretation than those they replaced. The original designations were retained for future exercises.
- The evaluation team appear to be generous in the number of maximum scores they assigned. Applying the maximum score implies that the system could not be improved in the way it meets the relevant sub-component. This could be valid for 'hard' concepts such as 'financial strength of supplier' under the Risk *perspective*. But it is hard to see, for example, how a maximum score could be allocated, as it was under the Process Redesign *perspective*, to a criterion as 'soft' as "facilitation of process approach to business". The participants justified their approach on the basis that, given the price of the proposed system, and the stable conditions in the Rolling Mill Department, the scores were reasonable in the circumstances.

  This approach however could give rise to a situation in which, in the context of a number of potential investments competing for limited funds, generous markings would provide an unmerited comparative advantage. The risks could be largely mitigated by applying such criteria to all projects being reviewed - that is, consistency could be maintained if the underlying principles of scoring were clarified and agreed on a company-wide basis.

13.4.5 Summary and Conclusions

<u>Summary</u>

Three major departures from the earlier research exercises took place in the case of Organisation 3. These were:

- The allocation of weight to the five *perspectives* was determined, not by an aggregation of sub-component scores, but by an overall score for each *perspective* based on discussions and the provision of other 'educational' material to senior management.
- The sub-components used for scoring were not generic as in prior research exercises, but customised to the environment in which the investments were made (see Appendix V). The number of sub-components per *perspective* varied considerably, with Payback applying 10, while Architecture applied only 3. This was addressed

by determining an average for each *perspective.*

- A brief, non-technical description of the five *perspectives* supplemented by a taxonomy of considerations for weighting and scoring under the five *perspectives* was provided for the first time. While not forming part of the formal evaluation process, they were used by management (and the consultants implementing the framework) as thought-starters and in addition ensured that the coverage of issues was comprehensive. It proved very popular with both management and consultants. This taxonomy is outlined in Appendix VI. This provided a series of practical thought-starters for participants for each of the *perspectives*. Under Payback, for instance, potential cost savings were provided, split under Direct Savings, (e.g. reduced inventories), Quality (e.g. fewer warranty claims), Productivity (e.g. less rekeying of data), Employee Performance (e.g. reduced need for training) and Management Performance (e.g. improved decision support capability). This greatly speeded the appraisal process and added to the acceptability of the framework.
- The concept of Probability was dropped. Whilst the original theoretical requirement for some form of probability analysis is still seen as valid, the earlier research showed that this was a major impediment for management, and when the subject was broached with this organisation's management, the response was even more negative than that encountered in earlier exercises. As management acceptability was seen as an essential research objective, this took precedence over the theoretical requirements. This shortcoming was addressed, at least partially, by the participants taking into account the reliability of the scores when assigning them. For example if a particular benefit merited a score of 9 under Payback, it would have been reduced to a lower figure if the probability of achieving the benefit was low. While this was not a perfect mechanism, it did address the probability factor whilst providing a framework acceptable to and workable by user and IT management.

Another innovation related to the Risk *perspective* being scored positively, whereas in previous research it had a negative value, which had caused confusion when assessing total system scores. Under the revised approach, where high risk applied, the component was awarded a *low* score, when the risk was low a high score was awarded - in direct reversal of previous applications. In terms of scoring the overall project, this was perfectly valid, and in fact could be seen as an improvement, in that it simplified the process and made it appear more consistent.

A new dimension was also added in that for the first time an exercise was undertaken without the direct involvement of the author. Consultants (admittedly work associates of the author) and line managers were able to effectively apply the framework in an actual business setting, in which reasonably large sums of money were involved.

Conclusions

The following conclusions could be drawn from these developments:

- The discarding of generic sub-components in determining weights resulted in a dramatically more positive reaction from senior management. In fact it is probable that had there been an attempt to build up weightings on the basis of sub-components, the senior management would simply have declined to become meaningfully involved. It was only through semi-structured discussion, supplemented with other explanatory material, that management achieved a level of understanding which enabled realistic weights to be assigned.
- Similarly, the customising of the sub-components for scoring made the exercise much more realistic for the IT Manager, and in particular, line managers, who for the most part did not relate, and/or were resistant to, generic concepts.
- These advances came at a cost however, in that a certain degree of consistency between proposals was lost. Comparative accuracy becomes more difficult to achieve when criteria are customised, irrespective of the qualities of those undertaking the investment. There is no doubt however that the exercises were far more realistic and effective in a business sense than those undertaken earlier.
- As with the earlier research exercises, management almost without exception is not well equipped to evaluate investments in IT. Payback is the only criterion which is understood in any meaningful sense, or in which an interest is shown. It takes time, effort, and the capacity to link generic principles to the participants' particular circumstances to undertake a meaningful IT investment appraisal exercise.

13.5 Organisation 4

13.5.1 Background

Organisation 4 is an international mail order business specialising in high quality goods. Even though IT is central to its operations, at the commencement of the research management saw IT almost exclusively in transaction processing terms. Following a period of prolonged growth, the company in1994 invested in new software and hardware facilities, supporting stock and mail order processing. Based on a recommendation of the supplier, the company chose a mini-based 'solution', which in fact turned out to anything but a solution. The systems, largely custom written, due the company's specialised requirements, had major problems, both in terms of quality and performance, and many issues of data integrity were also encountered.

The investment appraisal process, if it can be called that, was totally inadequate. It was made very rapidly, and was based mainly on system functionality, and to a lesser extent, price. Little else was taken into account. The development and implementation process, was not much better, with the development team operating in isolation from the users, who eventually had a system in effect 'dumped' on them. The subsequent failure should not have come as a surprise. In late 1995 management decided to abandon the system and to redevelop new software with a new supplier. This proposed investment was the subject of the research exercise.

13.5.2 Research chronology

Management did not learn adequately from their original experience, and going into the research exercise their primary goal seemed to be gaining retribution on the suppliers, and those internal staff (mainly the IT people) whom they saw as responsible for the disaster (which it was, with the investment being a virtual write-off after less than two years). As with all previous exercises, considerable preparatory work had to be undertaken before management became convinced of the need to apply a formal investment appraisal methodology. Again, abstract concepts achieved little resonance, and interest could only be gained by relating the elements of these concepts to their own experience. The participants in the process, apart from the author, were the Managing Director, the Finance Director, and the IT Manager (who was weak and partially discredited due to the failure of the original system). The investment being appraised was the development of a new stock control system, and a new mail order system, to be run in a client/server environment. The total cost was estimated to be £300,000.

13.5.3 Weighting

The Finance Director, and particularly the Managing Director, showed little enthusiasm for the exercise after the first few sessions. Interest increased when they were shown some examples for each *perspective*. For instance, a demonstration of the Internet which identified immense potential for mail order brought home the importance of Strategic Alignment and Process Redesign. A demonstration of interactive, 3-D multimedia showed how the right Architecture could provide the basis for exciting new sales support, while a combination of the latter two, combined with other telecommunications facilities, identified the possibility of moving sales support in-house, and eliminating sales agents in each country, as is now the case. This underlined the importance of Strategic Alignment, Architecture, Process Redesign, and indeed, Payback. Given their experience with the previous system, there was little need to convince the management team on the need for evaluating Risk.

As with organisation 3, specific sub-components were not weighted. The difference here was that a fairly comprehensive series of sub-components under the five *perspectives* was provided - these are outlined on Appendix VI. This underpinned both the weighting and scoring processes. This differed from Organisation 2 in that an attempt was made to make the concepts somewhat more generic. This worked reasonably well, *but it was found essential to relate the sub-components to the company's own circumstances.* Once that was done, the management team was quite comfortable undertaking both exercises

A summary of the weightings is outlined in Fig. 13.7.

Fig. 13.7 **Organisation 4: Summary of Weightings**

Perspective	Weight
Strategic Alignment	25
Payback	25
Architecture	10
Process Redesign	20
Risk	20
Total	100

13.5.4 Scoring

The Managing Director played little part in the scoring exercise, leaving it to the other participants in the exercise. Much of the initiative had to be taken by the author, with the company's management for the most part responding to questions and prompts. Nonetheless, each *perspective*, and the related sub-components, was examined in detail. A by-product of this was a significant increase in interest on the part of the Finance Director in architectural issues. At the end of the exercise he considered himself almost an expert on client/server technologies.

The final summarised scoring profile, which achieved a score of 635, is as follows:

Fig. 13.8 Organisation 4: Summary of Scores Adjusted by Weights

Perspective	Weight	Score	Adj. Score
Strategic Alignment	25	8	200
Payback	25	5	125
Architecture	10	7	70
Process Redesign	20	7	140
Risk	20	5	100
Total	100		635

13.5.5 Summary and Conclusions

The weightings reflected the realities of the investment environment reasonably well. From a position in which management saw virtually no significance in concepts such as strategic alignment or process redesign, their thinking had advanced to the point where strategic alignment was jointly afforded the largest weighting. Understandably, Risk was also afforded a relatively high weighting, and the management team found the exercise of scoring this category particularly useful, in that it identified for them a number of risk issues, especially in the areas of organisational impact and management commitment, which they saw as vital in their circumstances.

In being less enthusiastic and less well-equipped to carry out the exercise than any of the other participating organisations, this company imposed unique demands in terms of implementing the framework in an actual business setting. Nonetheless, the framework was applied, and, while the company planned to invest in any case, the investment decision arrived at was on the basis of its findings. In addition, management's understanding of the issues which underpin successful IT deployment have been greatly enhanced. This implementation was achieved however at the cost of a limited approach, in the sense that the perspectives and sub-components were treated somewhat cursorily. There was little evidence that the framework would form a long term component of the company's business processes, in the way it is likely to with other participants. In summary, the exercise represented a definite advance on existing approaches for the company, but fell well short of what could have been achieved. There is no way of squaring this particular circle, as effective IT investment appraisal in the absence of management commitment is a contradiction in terms.

13.6 Organisation 5

13.6.1 Background

Organisation 5 is a company in the telecommunications sector. It is technologically advanced, designing and developing a range of sophisticated PABX and network products for major providers such as BT and its Irish equivalent. The company previously undertook all its own manufacturing, but a few years ago took the decision to outsource this. It has also outsourced the delivery, installation and maintenance of its products, while retaining overall control and responsibility. In many ways therefore it could be regarded as a 'virtual corporation', a structure which demands unique requirements of IT, which plays a vital role in the effective running of this company, being heavily applied in every aspect of its operations.

The company's business and IT planning processes are also sophisticated. They developed a five year business strategic plan in 1992, and a corresponding one for IT. Both plans are seen as having contributed to the company's success, but at the time of the research taking place (early 1996) were deemed to be in need of updating. The lack of a structured approach to investment appraisal was seen as a significant limitation in the 1992 IT strategic plan, and management were keen to participate in the research. The company planned major investments in IT, specifically to replace the existing accounting and manufacturing systems with completely new applications. The objective was to apply the framework with a view to optimising these investments.

13.6.2 Research Chronology

The management team at this company was substantially different to those at all of the previous organisations. They were literate in IT issues, progressive, and anxious to learn everything they felt was necessary to arrive at the optimum decision for their company. It was decided to retain the variation of the framework used with Organisation 3, given its success with that company.

13.6.3 Weighting

An initial meeting was held with the IT Manager, Finance Director and Managing Director. The overall thrust of the project was reviewed, and it was felt that the best approach to working through the methodology was to undertake individual reviews with each of the senior management team, notwithstanding the additional time demands that this imposed. Each of this team devoted a considerable amount of time to understanding the principles underpinning the framework, and had achieved a thorough grasp of these principles before assigning weights to the five *perspectives.*

The composite weighting profile was as follows:

Fig. 13.9 Organisation 5: Summary of Weightings

Perspective	Weight
Strategic Alignment	30
Payback	15
Architecture	25
Process Redesign	15
Risk	15
Total	100

These weightings confirm the relatively sophisticated standards of this company's senior management team. The high weightings for Strategic Alignment reflected the team's appreciation of IT as a contributor to company objectives by means other than providing direct or tangible benefits. In saying this however, it must be noted that the Finance Director had assigned a weight of 30 to Payback, but in a group discussion held to rationalize the assigned weightings, accepted the revised composite scores. Again, while the IT Manager assigned a relatively high weight to Architecture, the unusually high score of 25 underlined the advanced level of IT awareness on the part of senior management.

13.6.4 Scoring

Three major applications were short-listed for appraisal, SAP, Oracle Financials, and Scala. A very comprehensive review of these products was undertaking using the framework, and the findings were debated in great depth with the management team. The main input was from consultants with the National Institute for Management

Technology, who directed the meetings and initiated activities. However, the management team was involved at all stages and played an active part in the exercise.

The full work-papers for this exercise are detailed on Appendix VII

13.6.5 Some Observations on the Worked Example

- The application of the framework has become more sophisticated

  The field work undertaken for Organisation 5 was the most recent and it will be readily seen that the application of the framework is both more comprehensive and more sophisticated. Much has been learned since its initial somewhat tentative application in Organisation 1 and the full report on the exercise represents a respectable document upon which management can base business decisions. In particular it will be noted that the exercise has become broader in scope, placing then investment appraisal issues in a more general business context. Earlier exercises were confined to direct investment appraisal issues.

- The taxonomy from Appendix VI formed the basis for the sub-components used.

  This was comprehensive enough to provide the bulk of material, which required to be supplemented only by elements specifically related to the company's business environment (e.g. the need for product data management) and specific technical issues (e.g. SQL and OLE compatibility).

- The total scores for each system were very close.

  The particular example shown, while of considerable value to the firm (eliciting a letter form the IT Manager to this effect) would have been more demonstrative, both form the company's perspective and for the purposes of this research had a clear winner emerged. However, while SAP scored the highest, the exercise could not be said to have presented management with a definitive choice. In fact, an analysis of the worked example shows that the Process Redesign *perspective* was crucial in providing SAP with its margin. This was mentioned by the Finance Director at the final meeting. His point was that he had hoped for a decisive result from the exercise. The reality however was that in terms of addressing the company's overall requirements, there simply was not a clear-cut winner.

13.6.6 Summary and conclusions

The framework applied for this exercise was almost identical to that used for Organisations 3 and 4. The investment appraisal process underlined again the following:

- Management are not comfortable with weighting on the basis of individual sub-components. They become quite confident, and indeed almost enthusiastic, about weighting their company's objectives and priorities when the concepts are clearly explained, ideally assisted by relating these concepts to their own experience and business environment. In this regard, the Taxonomy in Appendix VI was invaluable.
- Formal assignations of scores for probability would not have been acceptable to the management team. When broached, they described it as 'artificial' or 'academic'. No attempt was made to force the issue.
- The management team found it both useful and enlightening, and it lent greater confidence to the decision-making process. (The Finance Director stated that the process would be mandatory in future, and requested the relevant support documents for future evaluation).
- The full value of the framework will only be achieved when a 'corporate memory' of cases is built up for comparative purposes.

Postal Survey: IT Investment and Payoff Issues

Introduction

The original research methodology envisaged the requirement to set the findings of the fieldwork exercises in a broader context (Chapter 2.1.1). The objective was to ascertain attitudes to IT investment, trends in responsibility for IT expenditure, the state of current practice in terms of methods being applied, the degree of satisfaction with the investments themselves, and the methods applied in making those investments.

This survey was carried out in the period April/May 1996. The survey questionnaire was posted to 100 large/medium-sized companies, and the response rate was 41%. A consolidation of replies is provided on Appendix VIII. This very high figure reflected the increasing importance attributed to the subject by management. While the forms were posted to the Finance Directors, in many instances the IT director was the respondent. This ratio is not possible to quantify fully as, being a confidential survey, many respondents chose to remain anonymous.

The survey sought to address four main themes:

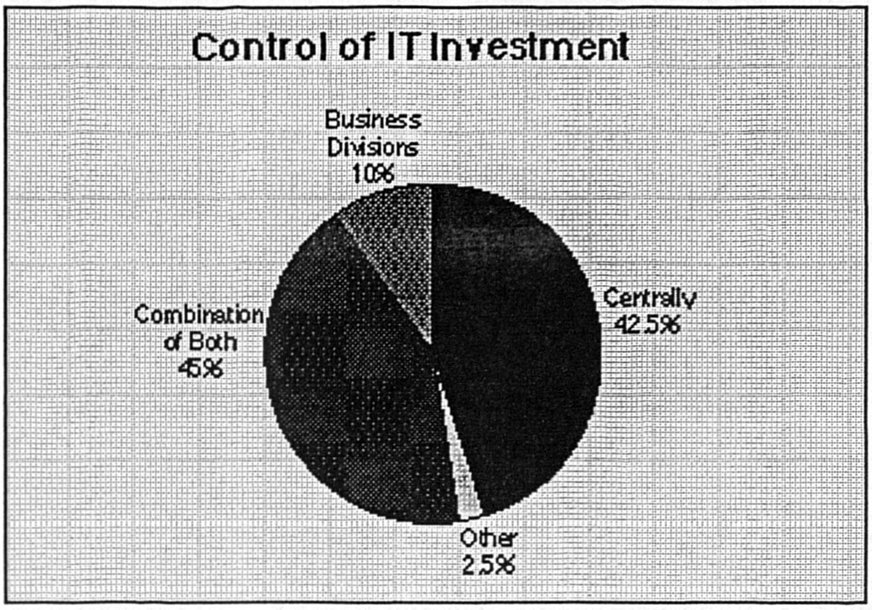
1. Current responsibility for budgetary control of IT, and perceived trends
2. The problems experienced, and the degree of satisfaction with IT investments
3. Investment appraisal methodologies currently in operation
4. The degree of understanding of IT investment appraisal issues by management

Summary of findings

Budgetary control

The control of IT expenditure remains firmly centralised, with 87.5% of respondents having their budgets either fully controlled centrally (42.5%), or in combination with the business units (45%). In contrast, only 10% of companies have business divisions responsible (see figure 13.10). While there is a trend, as anticipated, towards more devolved control, one in four of the companies shows an *increase* in centralised control.

Fig. 13.10 **Control of IT Investment**



When broken down by categories of investment, the results are predictable, with responsibility for mainframes and data centres residing strongly with the IT department (77.5%), with this control declining steadily through networks (72.5%), personal systems (52.5%), PCs (40%) and IT education/training (30%). (see figure 13.12)

Fig. 13.12 **Budgetary Responsibility of IT Function**

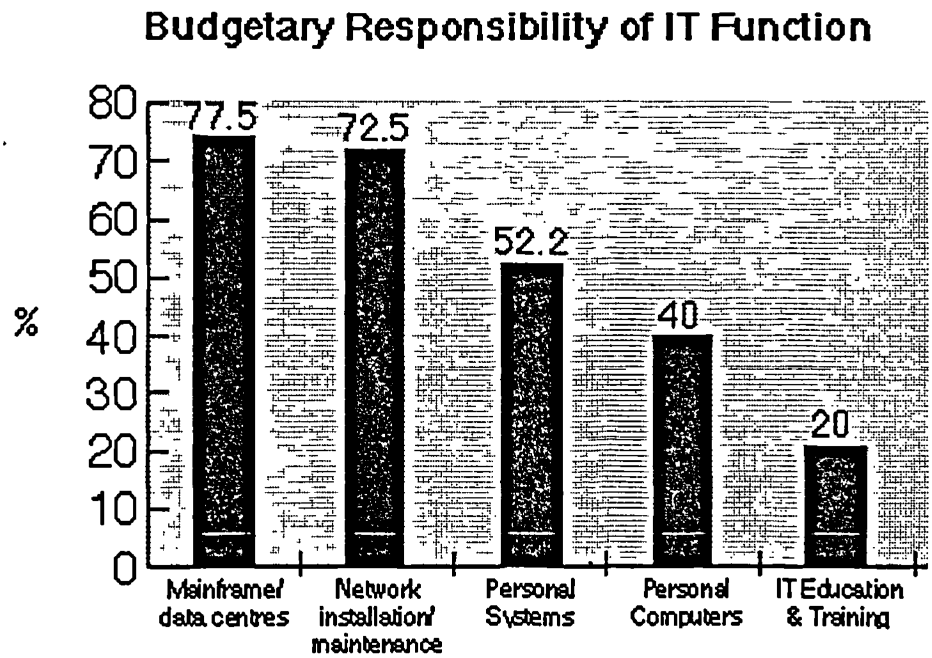


Figure 2.

IT Investment Appraisal

Problems and levels of satisfaction with IT investments

The replies suggested a high degree of satisfaction with companies' ability to assess IT costs and benefits. 85% of respondents claimed they were fairly successful or very successful in assessing IT costs, while the corresponding figure for IT benefits was 60%.

The problems related to assessing IT costs and benefits were identified in free text format, but have been broadly summarised as follows:

- No problems
- Administrative (inadequate accounting and identification of costs)
- Identification of hidden and end-user costs
- Technical considerations (development/implementation time scales, changes in technologies, unanticipated complexities)

The main problem identified by the overwhelming majority of respondents in assessing benefits related to the lack of metrics in relation to intangible benefits. Again, several respondents saw this area as not being a problem.

Appraisal methods currently applied

Over half of respondents (52%) have a standardised appraisal method in place, of which 50% in turn applied their own in-house method. Simple return-on-investment (ROI), represented by far the most common standardised technique, with a small minority supplementing this approach with discounting techniques such as net present value (NPV) or internal rate of return (IRR). The corollary of this of course is that almost half of respondents do not apply a standardised approach. Details provided on in-house methods were rather sketchy, but there is little to suggest significant use of comprehensive approaches. Regarding the success of these methods, 87.5% described them as successful or fairly successful.

Management understanding of IT investment appraisal issues

When asked to evaluate whether management had an adequate understanding of these issues, the aggregated response put IT professionals at 62.5%, line managers at 20%, and top management at 37.5% (see figure 13.13). It was noticeable that IT directors scored IT professionals' knowledge very highly, while Finance Directors rated that of top management almost as high. With line managers being underrepresented, it is perhaps not too surprising that they achieved such a low score.

<u>Fig. 13.13</u> Management Understanding of IT Issues

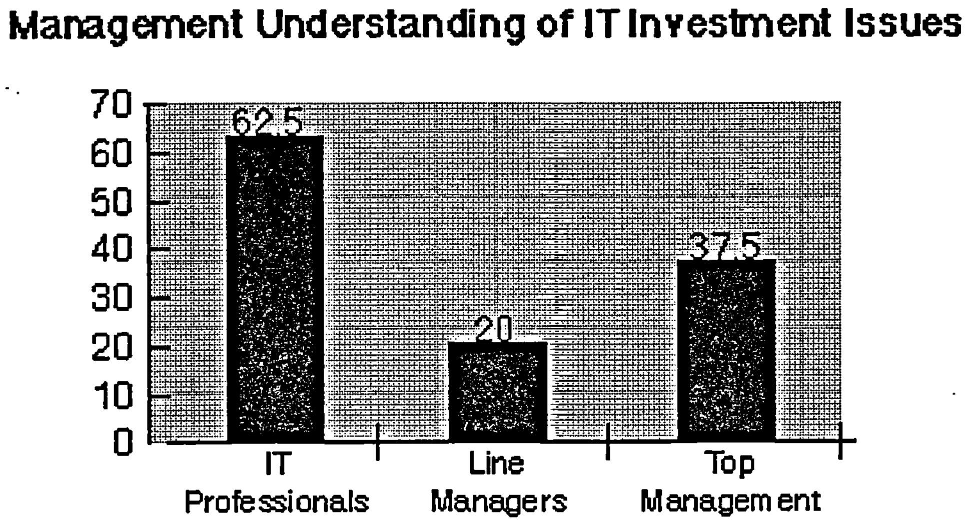


Figure 3.

Strategic alignment, architectural considerations, process redesign (BPR) and formalised risk assessment are complex considerations in investment appraisal, and, on the face of it, management seem to have recognised this, with 95% seeing strategic alignment as fairly important or very important, with architecture (77.5%), process redesign (72.5%) and risk (85%) being designated as important or fairly important (see figure 13.14).

<u>Fig. 13.14</u> Criteria Important to Evaluating Investment

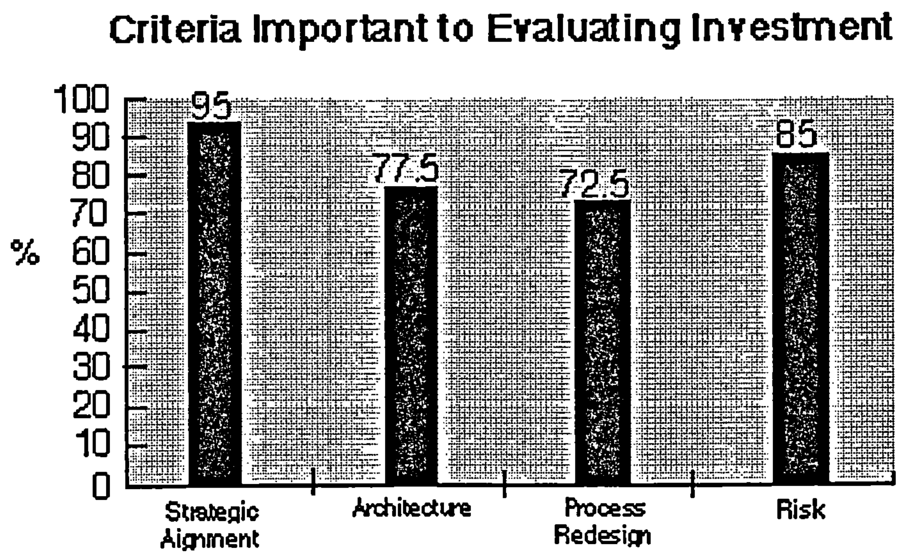


Figure 4.

Some observations on the survey

- Centralised control still very much alive

The results underlined the predominance of centralised control among most organisations. While about one company in three envisaged more devolution to the business units, one in four expected that centralised control would increase. This latter statistic will surprise many observers, who see budgetary control devolving inexorably to the business units. It could perhaps reflect concerns by senior management at the huge (some would say uncontrolled) growth of hidden costs in end-user computing, the so-called 'cost iceberg'.

- Unwarranted satisfaction on ability to track costs and benefits

The satisfaction felt by respondents in their ability to assess IT costs and benefits mirrors that in the UK. Unfortunately this satisfaction may be unfounded. Given the evidence cited in Chapter 1 to the effect that only a minority of projects provide the anticipated return, the survey itself raises doubts as to whether such satisfaction is merited. For instance, a mere 5% of respondents saw their investment appraisal methods as being fairly or very successful, only 27.5% of systems delivered targeted or above-targeted returns, while only 30% of projects were completed to budget.

It is difficult to reconcile these responses with the optimistic assessments on the ability to assess costs and benefits. The response from the Finance Director of a major retailer in relation to costs, benefits and project performance - 'I'd hate to find out' - suggests a more realistic view than those professing 'no problem'. This raises questions on the extent to which management understands the key investment appraisal issues.

- Much work still to be done on management awareness

Research has shown that the factors identified in Question 6, strategic alignment, IT architecture, BPR and risk, are essential components of the appraisal process, and the relatively high degree of importance assigned by the respondents seems to underline this. However, apart from two mentions of strategic alignment, not one of those factors featured as part of the methods currently applied amongst responding companies. One possible explanation is that while there may be a vague feeling that such factors are important, there is no mechanism to incorporate them as part of the appraisal process. In the course of a number of investment appraisal exercises undertaken by the NIMT, IT Directors claimed that while they saw these factors as highly important, they were reluctant to broach them with senior management due their lack of awareness, and the consequent risk of muddying the waters.

- Investment appraisal methods remain rudimentary

Almost half of respondents apply no consistent or structured approach to investment appraisal, while the bulk of the remainder apply techniques such as payback and ROI which capture direct financial benefits only. It is possible that such a focus may be worse than useless, in that by lending a spurious authenticity to the exercise, it forces out consideration of potentially more important issues such as strategic alignment, architecture and BPR.

All in all, the findings give some cause for concern. Despite IT now absorbing up to 50% of new capital expenditure, and the investment environment having changed substantially, the number of companies applying appropriate techniques remains very small, in all likelihood reflecting the inadequate levels of awareness on the part of senior management.

<u>This closely relates to findings in the fieldwork elements of the research, which showed that inadequate investment appraisal methods were being applied, leading to unsatisfactory returns, and originating in large part from an inadequate understanding of the true impact of IT on the part of management.</u>

Executive Briefing Days

Executive Briefing Days are geared towards creating awareness for a small group of managers on specific IT issues. Typically, these will be attended by four or five senior managers from a single company, and a workshop style of organisation applies. These occasions have provided an excellent forum for airing and evaluating the framework, especially as the National Institute for Management Technology (NIMT) now addresses other IT activities (e.g. strategy) from the standpoint of the five *perspectives.* The framework has achieved widespread acceptance as a tool for investment appraisal, once the concepts are understood. This latter requirement frequently takes a lot of time. Other areas which paralleled the findings from the five full applications of the framework were the desirability of expressing concepts in terms of issues with which the participants are directly familiar, and the lack of enthusiasm for formal assessments of probability.

Summary

In line with the original research objectives, the framework was applied in a range of organisational settings. The organisations ranged widely in terms of appreciating IT issues and management commitment. The local authority was least advanced, but to be fair, having completed the research in the five organisations and held a large number of Executive Briefing Days, it is clear that the final version of the framework (that which applied from Organisation 3 onwards) would have been far more acceptable and practicable from the local authority's perspective. The refinements made to the framework, together with the supplementary aids (in particular the taxonomy in Appendix VI) resulted in it being seen as far more relevant to management. The framework had fully bedded down by the time the research was begun in Organisation 5, and this very advanced and demanding company was able to apply it with virtually no alterations. The main refinements were:

- the allocation of weighting to the *perspectives* on the basis of discussions with management, (which in turn was based on a review of business objectives) rather than on pre-defined sub-components.
- The replacement of pre-defined sub-components for scoring with a taxonomy of investment considerations under each *perspective*, with the additional flexibility of allowing these to be customised to reflect individual company requirements.
- The dropping of the formal application of probability factors.

The end result was that the framework was successfully applied in a number of companies, and was adopted by most participants in the Executive Briefing Days. Since the end of the formal field research it continues to be applied in its present form in a large number of companies. Despite this progress, the survey on IT investment issues shows, *inter alia,* that management understanding of key issues still leaves a lot to be desired. As long as this situation applies, difficulties in achieving business benefit from IT are likely to remain.

Chapter 14. Summary

The global context in which the research commenced was one in which cultural, economic and commercial realities were undergoing rapid and fundamental change. This change was shown to have been largely driven by rapid development in technology, particularly information technology (IT). Despite its impact, and the vast sums of money being spent on it, it was failing, by many orders of magnitude, to provide appropriate improvements in productivity. A very high proportion of IT projects were shown to have provided minimal return, and dissatisfaction with IT investments was expressed by management. This raised a question on the appropriateness of investment appraisal techniques.

Despite the radical commercial and economic changes which had occurred, with real value being increasingly represented by the control of information rather than physical assets, investment appraisal techniques continued to be dominated by finance-based criteria, so-called 'hard benefits'. A review of these, and conventional accounting and finance-based approaches to IT in general, showed them to be not only inadequate, but possibly counter-productive, in that misleading results could occur. Their continued widespread use was explained, at least partially, by way of a review of the historical development of IT and its changing role and application within organisations.

This set the scene of the research focus, which was to develop an IT investment appraisal framework, and to test it in field conditions under two criteria:

- Suitability: Would it meet the requirements of the present economic and technological environment? In other words would it be an advance on current techniques?
- Acceptability: Given the general practice of management up to now to apply traditional techniques, would the new framework be acceptable? The validation of this objective would be the extent to which the framework would be applied in actual organisational settings.

The decision was taken to focus field testing on medium-sized organisations. This was based on employee numbers being in the range of 100 to 500 employees, and/or a turnover in the range of £50 million to £300 million. This was seen as being particularly appropriate in the Irish context, and also providing a greater degree of consistency when comparing the results of the fieldwork.

A detailed review of IT research methodologies and practice was undertaken, and while action research was seen to be the most appropriate, other methods were to be incorporated as the circumstances demanded. The research programme chosen was to first develop a theoretical framework based on relevant literature and practice in the field. This framework was to be applied in a number of operational settings. This would be further refined in the light of field results, until an acceptable and consistent framework had been established.

Before defining the framework it was felt necessary to examine the evolution of IT and place the current research objectives in their historical context, from the transaction processing of the earliest installations, though inter-departmental systems, then personal and distributed computing, through to the business transformation capabilities of IT in current times. The relevant investment appraisal techniques that applied in each phase were analysed. This analysis showed that while the application of IT, and the price performance ratio of computing power both showed dramatic changes, investment appraisal techniques had not evolved to reflect these changes.

The analysis also identified that business value arising from IT investment was increasingly represented not so much by direct benefits (such as cost reduction or direct revenue enhancement) but in an indirect and less tangible way. Conventional investment appraisal approaches were seen to be singularly unsuited to identifying and placing a business value on this type of benefit. The growth of distributed, personal and client/server computing also rapidly increased the growth of multi-vendor IT establishments. This was in contrast to earlier phases when most establishments were dominated by one or two large vendors. This development meant that architectural consistency assumed much greater significance, and in addition broadened the variety of risk to the investment and project management process.

A literature review and an analysis of current practice formed the next step. Many researchers and practitioners focused on particular aspects of the appraisal process (e.g. strategic systems) rather than on providing comprehensive frameworks. Nonetheless, a range of key criteria or determinants for the appraisal process was identified, as was the degree of importance attached to them by the various researchers and practitioners. These criteria, and their suitability for inclusion in the proposed framework, were then reviewed in detail. It was established that a number of key elements were essential for the framework. These were:

Strategic Alignment, "a state of harmony between the goals and activities of a business and the computer systems that support them" was seen as essential due to the extent to which IT has become a key enabler of all business processes. Linking IT and business strategies therefore has assumed considerable importance, especially in the light of the rapid rate of technological change .

Payback needed little justification, in that it bordered on self-evident that the possibility of achieving direct benefits should be a factor when evaluating IT investments. Given the trend from manufacturing to services, the relative decline in the importance of direct benefits was highlighted, nonetheless, the importance of performing some form of benefits measurement was stressed.

The *IT architecture* was shown have become much more complex in recent years, with the likelihood of this complexity increasing. The main issues contributing to this complexity were reviewed, and it was established that neglecting the architectural ramifications of IT proposals could seriously undermine their business value.

Risk is another *perspective* whose incorporation in the framework should have been almost self-evident, yet it was shown that comparatively few organisations formally apply risk evaluation techniques. This was despite the high level of failures and disappointing outcomes associated with IT investments. It seems clear therefore that a formalised evaluation of risk must be a factor in the investment appraisal process. The types of risk were reviewed, with special emphasis on the relative increase in importance of human and organisational considerations.

Process Redesign introduced a perspective which was almost totally missing from other approaches identified in the literature. The inclusion was justified by establishing that today's business organisational structures remain based on theories originally formulated over 200 years ago, theories which emphasise a hierarchical form of control. This was shown to be unsuited to the requirements of today's business environment, which must respond to calls for short product development and life cycles, tougher competition, volatility, and a rapid increase in the incidence of mergers/demergers, acquisitions/divestitures. This can often be accomplished by a form of radical business process redesign, usually underpinned by IT, and frequently driven by IT capabilities. The widespread application of process redesign concepts, and the unique role of IT, suggested that potential IT investments should be evaluated under this *perspective*.

These represented the five primary *perspectives* which would form the basis of the proposed framework. Given that the relative importance of these criteria would vary between organisations, it was deemed essential that management apply a weighting using a range of sub-components for each *perspective*. The proposed system or systems under review would then be scored against each of the criteria, with the score adjusted to reflect the respective weightings. A form of scoring based on management's business and technical judgement was deemed to be the only practical way of evaluating an investment's potential value, as attempts by researchers to assign monetary values to all potential benefits were assessed, but found to be unrealistic. Finally, the issue of probability was addressed by assigning a probability factor to each of the criteria, reflecting the degree of certainty with which the various scores were predictable.

This framework formed the basis for the field research, which was aimed at validating the research objectives, namely the *suitability* and *acceptability* of the framework in a setting of small to medium sized organisations. The field work was carried out in five different organisational settings; one local authority, one semi-state companies (just about to be privatised) and three private companies. The research took the following form for each organisation:

- a review of organisational objectives
- an explanation to management on the problems currently associated with IT investment appraisal, a presentation of the framework and the rationale behind it (the form of which varied according to the management's awareness of the issues and the degree of interest).
- the identification of an appropriate project for the application of the framework
- the application of the framework in this project by the management team, supplemented by the author and/or other consultants with the necessary skills and knowledge
- a review with management of the suitability and acceptability of the framework

The experience with the first organisation, a local authority, was not encouraging. Management was almost wholly unaware of the significance of all *perspectives* other than that of Payback. An academic type paper (Appendix II) presented as an explanation of the concepts was grasped by only a few of the management team, although in retrospect it can be seen that an academic type paper was not the ideal format. A major problem was encountered in that many of the pre-defined sub-components for each *perspective* (e.g. market turbulence) were unsuited to a local authority. The relevant sub-components were redefined to reflect local authority circumstances, but the credibility of the exercise had, to a certain degree, been undermined. The issue of probability was not addressed as the management team felt that enough 'academic' weightings and scorings had been undertaken. Despite all of the reservations, the exercise was completed. While its acceptability had to a degree been reduced, the low score that the proposed system achieved caused all concerned to revisit many of the assumptions on which the intention to purchase was based. It was found that the original decision had omitted or under-represented several important elements which had in fact been identified by the use of the framework. This applied particularly under the Risk and, to a lesser degree, the Process Redesign *perspectives*. To this extent the framework can be said to have had some success in terms of relevance and suitability.

The application of the framework in the second organisation was much more successful. This company, a pharmaceutical manufacturer, had previously had a very bad experience with a IT investment and were anxious not to repeat the failure. The strength of their intentions was underlined by their having a special board meeting to discuss the application of the framework. The framework was explained in a question and answer session and supplemented by a list of questions to enable the management team to define organisational priorities. This team achieved a reasonably good grasp of the concepts underlying the *perspectives*, although this varied considerably between individual managers and departments, with marketing and sales being particularly weak. Again there was an issue with the suitability of some sub-components, although in this case it related more to the absence of pharmaceutical-specific criteria, such as those bearing on compliance.

What was significant here was that the team suggested some sub-components which they felt would have been more suitable. This made a lot of sense but the author took the position that the framework as it stood should be applied in interests of cohesion. Again there was no enthusiasm at all for applying probability factors, even though the validity of the concept was accepted. These were omitted from the exercise. The exercise itself was performed quickly and easily. Management felt that it had been worthwhile, had revealed a lot of important issues, and had forced them to systematically think through issues which would otherwise have been ignored or skimmed over. One notable finding from the exercise was the relatively low weightings awarded to Strategic Alignment and Process Redesign. This certainly did not correspond with the company's business environment and priorities (as defined by the management team) and suggested that the sub-components underlying these *perspectives* were not fully understood or appreciated.

Significant progress was made in Organisation 3, a company engaged in heavy industry. Major advances in management appreciation of the cost/benefit dynamics of IT investments were identified, and acknowledged as such by the management team. Based on the first two research exercises, a number of changes were introduced to the framework. The principal initiative was to dispense with sub-components used for weighting the five *perspectives*. In their stead, management was 'educated' on what the *perspectives* represented, in a semi-formal manner, with particular emphasis on relating their meaning to the circumstances of their own company. This proved to be a major advance in terms of understanding and acceptability, to the extent that it was incorporated in all future applications of the framework.

The other significant initiative introduced was to customise the scoring sub-components to reflect conditions in the industry in which the company operated, while retaining the basic principle of sub-components. This may have reduced the opportunities for comparisons between different exercises, and consequently the cohesiveness of 'corporate memory'. Yet the resulting increase in acceptability and understanding more than compensated.

The success of the framework in this company can be judged by the fact that it was used to evaluate several further projects (some of which did not involve the author in any capacity), and at time of writing, is being considered by the parent company for use on a world-wide basis. Formal approaches exploring this possibility have been made to the author.

Organisation 4, a company with a world-wide mail order business, just had a bad experience with their previous investment in IT. They were anxious to apply a more methodical approach, but it took the demonstration of a number of case studies in their own industry, and based on the five *perspectives*, to bring home the significance of the proposed approach. Once again it was seen that it is difficult to attract and retain management's attention with abstract concepts. Once the relevance to their own industry had been demonstrated, a marked improvement in interest and participation became evident.

Exactly the same form of the framework used in organisation 3 was applied with this company, and the exercise showed no need to change it. While the management team did not spend an enormous amount of time on the exercise, it did nonetheless form the basis of their purchasing decision. They also acknowledged that they had a far better understanding of the investment appraisal process than previously, and that the framework had identified and helped address all the key issues. The overriding impression left with the author however was one in which a less than fully adequate commitment by management resulted in a less than optimum outcome.

The final company applying a full application of the framework was a fast-growing enterprise in the advanced telecommunications sector, and the exercise related to the selection of one of three major software packages. Their business and IT planning was sophisticated, and little or no effort was required to persuade the management team of the need for an investment framework. In fact, so much interest was taken by so many managers that the project vastly exceeded the projected timings. Again, the same version used in the previous two exercises was used here, and at the completion of the exercise there appeared to be no need for changes. The exercise was carried out with great rigour and precision. While no stone was left unturned in the interests of accuracy, like all other participants, the management in this company were not enthusiastic about formally applying probability factors. From conversations with senior management, it seems likely that the framework will be applied in future investment decisions.

This developments suggested that the framework as amended for Organisation 3 has achieved a good level of acceptability. And whereas it may be somewhat less cohesive than the original, it is very much ahead in terms of acceptability and practicability. These characteristics were also evident in the Executive Briefing Days held by the National Institute for Management Technology (NIMT), in which the framework found practical application, not just for investment appraisal, but in terms of overall evaluation of companies' systems.

The postal survey on IT Investment and Payoff Issues was a useful component of the research. Most importantly, it emphasised the extent to which management, even in the largest and most advanced corporations, by and large still lack the requisite skills, experience and indeed mindset to enable them to successfully tackle these issues. While the proposed framework undoubtedly helps to ameliorate these deficiencies, as long as they exist the achievement of satisfactory returns from IT investment is likely to remain problematical.

Overall, it can be said that the framework was developed in the light of historical developments and existing research and practice, that field tests suggested modifications to the original structure, and that these modifications resulted in its achieving widespread acceptability in the organisations in which it was subsequently applied. In some organisations it seems that the framework will form part of future investment appraisal exercises. The results should be of interest to both researchers and practitioners in seeking to reconcile the need for comprehensive coverage of the key investment appraisal issues with management's limitations in terms of both knowledge and commitment.

Chapter 15.
Conclusions, limitations, and recommendations for further research

15.1 Introduction

When setting out on this research I had somewhat mixed feelings. The issue of IT investment appraisal I had seen as one which I had not seen dealt with in an effective way in a computer career that exceeded twenty years. The methods I personally applied, and saw applied by a large number of very different organisations seemed to be unduly mechanistic and inflexible. Almost all available data showed IT to be providing a poor return on investment, with a high proportion of projects showing minimal return. As the use of computing grew and spread, I saw the difficulties becoming correspondingly more intractable. In particular, management seemed to be particularly ill-equipped to address the increasingly complex issues, and financial considerations continued to dominate despite what appeared to be their growing unsuitability.

Despite the growing importance of IT to their organisations, and the poor return on their investments, management showed little inclination to come to grips with this issue, either handing over the problem to technical staff, or adopting a narrow simplistic approach to it. While much research had been undertaken in the academic community and by practitioners, and much that was valuable produced on aspects of the problem, only a handful of comprehensive frameworks were available to assist management in the decision-making process. It was with this background therefore that I undertook the research, to define a framework that was *practical*, in that it would enhance the decision-making process, but also that would be *acceptable to management*. This latter requirement was important given the widespread reluctance to engage the issues on the part of management.

Having completed the research over several years, the following summarises the conclusions I have reached. Also included is a review of the framework's limitations, and recommendations for future research.

15.2 Conclusions

1. The framework was found to be acceptable to, and applicable by, management in a range of organisational settings

The framework, particularly as refined after Organisation 2, proved to be an acceptable and practical tool for management. In Organisation 3, 4, and 5, management were able to link it to their operational needs, worked on completing the exercise, and in most cases based the eventual investment decision on the results of the exercise. Indeed, in the case of Organisation 3, approaches have been made by the company to make the framework an international standard for IT investment appraisal.

2. Current standards of investment appraisal are inadequate and will continue to be until management limitations in terms of knowledge and commitment are addressed
Management in all organisations partaking in the research, and in the NIMT Executive Briefing Days, were, with a few exceptions, inadequately prepared to successfully undertake investment in IT. Their thinking was rooted in the Industrial Age, with direct benefits and financial considerations predominating. It was repeatedly found in the course of the literature research that this form of thinking was not only inadequate, but in the context of IT investment appraisal could possibly give rise to misleading results.

3. Process redesign (or reengineering) was accepted as a valid IT investment criterion
The comparatively recent emergence of process redesign (reengineering) has resulted in none of the current methodologies explicitly incorporating it as an investment criterion. Chapter 8 proposed that it was an essential criterion, and, while admitting the need for considerable education on the subject, this was accepted by participating management. In some instances (Organisations 2 and 4) this was scored much lower than circumstances appeared to indicate, but this was almost certainly due to the factors referred to in Conclusion 1. The postal survey (Chapter 13 and Appendix VI) also provided strong support for the concept's inclusion.

4. Generic concepts have little relevance for management
Weightings and scorings in the first two field experiments were based on generic subcomponents under each of the five *perspectives*. Management found it difficult to relate to them, to the point of losing patience on occasions. It became clear that the underlying principles could only be made relevant by way of an informal 'education' process, and then defining them in terms directly related to management's operational conditions. When this was done, commitment and understanding improved dramatically, although to an certain degree the cohesiveness of the framework may have been reduced.

5. The framework has the potential for very wide application
The issue as to whether one framework can be appropriate for (a) different types of system and (b) different types of organisations, has attracted much attention. It is proposed

that the organisations in which the framework was applied differed substantially, from a local authority to a very competitive high-tech communications company. It is further suggested that if the framework as refined for Organisation 3 had been applied in Organisations 1 and 2, the level of acceptance there would have been significantly greater. This suggests that a single framework can have wide application. The one limiting factor was size, with the largest participant having 550 employees, suggesting that things could be different with much larger companies. Indeed, the postal survey, which focused on large organisations, showed that they did have higher levels of sophistication. Nonetheless, widely varying fields of operation did not seem to unduly challenge the framework. In fact, within the National Institute for Management Technology (NIMT), the framework is used to assess the value of investing in such things as training courses and CASE tools. Furthermore, management education programmes are now based on these concepts, with the emphasis being on the need to achieve a holistic view on IT's impact. The framework also forms the basis for the development of IT strategies for client organisations of the NIMT.

6. Applying the framework deepened and broadened management's understanding of the key investment appraisal issues

Almost without exception, the participants in the research confirmed that the experience had added a new dimension to their understanding of IT and in particular IT investment appraisal. This has lead, *inter alia*, to the five *perspectives* being used by the National Institute for Management Technology (NIMT) in a much broader range of services such as management education (see Conclusion 4).

7. Deeper analysis is required

Meeting the requirement for acceptability imposed limitations on the comprehensiveness of the analysis, with the degree of acceptability declining almost in line with the extent of the comprehensiveness. This was particularly evident in relation to the application of probability factors. The research leading to the development of the framework strongly suggested that the probability factor needed to be incorporated as part of the appraisal process. Yet, without exception, participating management were reluctant to formally apply such factors as part of the exercise.

8. The framework works best when the concept is first introduced to the management team as a group, and subsequently refined by way of structured interviews.

While group discussions were valuable, the need for individual interviews became clearer as the research progressed. The latter approach mitigated the problem of forceful personalities dominating the group sessions, and also enabled participants to clarify conceptual issues on an individual basis. In this context, the taxonomy used in Appendix VI proved particularly useful.

15.3 Limitations

The application of the research does suffer from a number of limitations, which should be recognised.

1. Limited range of organisations researched

Whereas the range of organisations chosen was fairly wide (see Conclusion 4), it was limited in terms of organisation size, with the largest employing 550 staff. This opens the possibility that the research would not be replicated in large organisations. This is borne out to some degree by the postal survey, carried out amongst Ireland's largest companies. This suggested, *inter alia*, that concepts such as strategic alignment, process redesign and architecture were accorded a degree of importance in excess of what was afforded by the research participants.

2. Undue impact of influential participants

The research made clear that participating management who had respect and/or influence, and those who adopted an aggressive stance during weighting and scoring, had an influence in excess of that which their contribution merited (this was particularly noticeable in Organisation 3). Similarly the impact of managers with lower levels of commitment to the appraisal process was less than their more committed counterparts, irrespective of the merits of their contributions. This however is always going to be a risk where management judgement forms the basis for scoring and weighting. The inevitable distortions could be reduced by building up a bank of 'corporate memory' of investment appraisal case histories, and by making the exercise more structured.

3. Boundaries on the focus of the appraisal

The issue of 'what constitutes a computer system' was discussed in Chapter 11. Rapidly changing user demands during the development cycle, the sharing of data and resources between different systems, the growth of end-user computing, the increasing proportion of IT resources associated with telecommunications, and ongoing maintenance/enhancements of functionality after implementation all combine to blur the distinctions between applications. It is difficult therefore when undertaking an appraisal to be certain that the subject of the appraisal (and hence the scores and weights assigned) can be viewed as discrete elements.

4. A single essential factor can be submerged in the overall scoring
As the framework stands, a single factor, which can be of overwhelming importance in its own right, can be outweighed by a combination of other criteria. For instance when evaluating the risk *perspective* at the local authority (Organisation 1), the possibility of trade union non co-operation was seen as a strong possibility, and was assigned an appropriate score. Yet, when the exercise was finished, this had been partially submerged by high scores on the other *perspectives*, and even within the risk *perspective* had had its impact weakened by high scores on other sub-components. As things turned out subsequently, such opposition had major impact on all of the authority's IT initiatives. This need not be a major weakness once the possibility of such a distortion is recognised and catered for from the outset.

15.4 Recommendations for future research

This research suggests that management can gain considerable business benefit through the application of formal methods in IT investment appraisal. It also provides the basis for further research in a number of areas, not least those where limitations have already been identified. The following are suggested:

1. Assess the appropriateness of the framework in large organisations.
In line with the research objectives, the framework has been applied only in medium-sized organisations. Indications from the postal survey suggest that larger organisations are more sophisticated and knowledgeable. Future researchers might adapt elements of the framework, or add new ones, to reflect the requirements of large organisations. This research might also identify whether derivatives of the framework could be devised to better match the demands of different industry groupings.

2. Address the problem of system scope
As indicated above (limitation 3), the definition of parameters on the scope of a system is becoming increasingly difficult. This subject has received comparatively little attention from researchers up to now, and has implications beyond that of investment appraisal. - project costing and internal billings are two activities that spring to mind. Research which suggested ways of identifying parameters for the scope of systems could prove useful.

3. Identify more acceptable method(s) for incorporating probability
The unwillingness of management to formally incorporate probability factors has been

referred to above. Future research might seek to identify new methods or approaches which would make management more receptive to formally applying this important concept as part of the appraisal process.

15.5 Summary

During the course of the research the rate of change in the IT industry continued apace. This change was paralleled in the manifold organisational settings in which IT was applied, and continues unabated. The rate of change was accompanied by continued dramatic growth in IT usage, both in terms of depth and spread. Only the very smallest of organisations can now get by without the use of IT, and in fact few do. The spread in usage, particularly the growth in end-user computing, posed a whole new set of challenges in terms of achieving value-added from investments.

Given all of this, it would be assumed that management at all levels and in all organisations would designate successful IT investment as one of their top priorities. Yet, while management may complain about inadequate returns form IT, they have done remarkably little to acquire the appropriate skills. If senior management displayed a similar ignorance on finance and marketing matters they would be unlikely to survive (or get there in the first place). Yet some seem to wear this ignorance almost as a badge of pride.

Perhaps it all really comes down to the fact that we really are undergoing a paradigm shift, that we are now at the cusp of the Information Age. Although as profound and traumatic as the Industrial Revolution (perhaps even more so) it is taking place in a fraction of the time. It is to be expected therefore that accepted truths cannot be rapidly jettisoned or displaced. It is in fact fully understandable that management, brought up in an era of cost benefit analysis and financial justification, should struggle to find common ground with the rush of technological developments swirling around them. This became particularly clear during the research when Process Redesign was introduced as an essential perspective through which IT investments should be evaluated. To accept this first required the acceptance that we were in fact going through a paradigm shift, and secondly that IT was an essential - if not the main - enabler of this shift. In most cases these concepts were grasped only with great difficulty.

Providing the appropriate level of education and awareness must therefore surely rank as one of society's primary objectives. For many senior managers approaching the end of their careers, it is probably too late, but for the others the outlook, in the right circumstances, appears promising. One of the most encouraging outcomes of the research was the extent to which participants gained a rapid understanding of the key issues, and took them on board. While not wishing to over-state the case, the research exercise created a radically improved understanding of the issues, an understanding which did not take copious amounts of time to acquire.

This increased understanding, welcome as it was, is only the beginning however. To fully apply IT effectively requires a new mindset, one which sees IT as central to organisational effectiveness. This mindset must also accept that purchasing the right hardware, telecommunications and software represents but the first step. Added value will only come when IT investment is underpinned by the correct strategy, and accompanied by benefits management, accountabilities, information management policies, capable and motivated personnel, and the capacity to accept change as normal.

Progress is usually based on learning from what others have tried, and benefiting from their experience. It is hoped that the research presented here, based in turn as it is on the learning and innovative thought of others, has gone some way to assist in the field of IT investment appraisal. In particular it is felt that some of the techniques to aid better understanding of the key issues, and the incorporation of process redesign as a discrete appraisal criterion have cast some new light on the subject. While acknowledging that many difficulties remain (and others are likely to arise) any contribution to the resolution of one of today's most intractable business challenges should be of value.

Appendix I

Investment Appraisal Process: General Motors Main Dealer

Background

The author was retained in 1986 to advise a large GM dealership on the purchase of a computerised computer system for the motor trade. This company envisaged that this package would:

1. Handle increased business without additional staff by way of automating existing labour intensive routine tasks

2. Effect savings in the parts warehouse by reducing inventory levels and obsolete parts, and
by capitalising on faster delivery of sales and stock data, to avail of special purchase discounts from the manufacturer.

3. Achieve significant time gains in the issuing of invoices and statements, thereby improving cashflow. The anticipated reduction in errors and inconsistencies in this area would also improve cashflow and reduce time lost on investigations and corrections.

4. Provide the capacity for workshop costings to be undertaken at a level unfeasible using
manual methods.

The Selection Process:

An *ad hoc* group was set up for the purposes of selecting an appropriate systems solution. This was comprised of the author, the firm's financial controller, and a representative from the firm's auditors. Functionality and price were the primary considerations in the selection process. The choice was narrowed down to three alternatives, a PC-based solution, a Unix based solution, and one mini-based solution, with a proprietary operating system. The justification was based almost entirely on financial considerations. The impact of automation in terms of cost savings in the relevant areas of the dealership were analysed in detail, as were the cost elements of the proposals from the three suppliers. Much attention was given to comparative costs for elements such as price-per-MIPS (millions of instructions per second), printers, storage devices, and annual maintenance charges. Savings on headcount and overtime were studied in similar detail.

Costs and benefits were estimated over five years, and NPV and IRR calculations were performed on the three alternatives, while their relative performance and functionality were also compared at some length. More broadly-based issues relating to business value added did not come into the equation. The PC-based solution was rejected on the basis of functionality and performance, while that based on Unix was rejected on the basis of cost. It was felt that the mini-based proprietary solution provided the desired functionality at a very competitive price, being broadly in line with that of the PC alternative. This competitiveness stemmed in no small measure from the fact that at this time manufacturers of minis saw the writing on the wall as it were, for these systems.

The author did not concur with the selection, due mainly, it must be said, for technical reasons. These were based on the rapidly improving price/performance of PC solutions, the continuing development of more robust LANs, and most importantly, the lack of future flexibility associated with the proprietary solution.

The Result:

Most of the objectives specified for the system were in fact achieved. However, costs for
training and maintenance proved to be far in excess of what the manufacturer estimated at time of tender, and the whole implementation process proved to be slower and more disruptive than was envisaged. Hardware upgrades were required much earlier than expected. Software amendments required to address defects stemming from inadequate specifications at the implementation phase, and ongoing business requirements, proved to be far in excess of what the dealership envisaged.

The system began to be progressively replaced after a few years, with more and more functionality being transferred to at first individual PCs, and then to a LAN. This was for the following reasons:

Ongoing maintenance costs were too high.

Hardware, and particularly software, support from the supplier were poor (old technology) and expensive. Being proprietary hardware and software, support could not be obtained elsewhere.

The performance economics of the PC/LAN environment became overwhelmingly favourable.

Demand for office productivity tools (spreadsheets, word processors and desktop publishing) grew rapidly, but could not be integrated with the main system.

Most important, the dealership was compelled as part of his franchise agreement to set up a link to automate the parts supply operation with the manufacturer. The costs associated with implementing this on the existing platform were simply prohibitive.

Conclusions:

In this case, the functional objectives of the system were clearly defined, and the potential financial savings quantified. In both instances, the target were largely met. It should have been a very successful installation, yet the system had to be sidelined at great financial cost, in a little over two years. This underlines the limitations inherent in financial evaluation techniques used on their own. The attention applied to the technology was almost exclusively confined to cost/performance issues. Intangible benefits were not taken into consideration in any systematic way (the author accepts his portion of blame), and long-term technical considerations, despite being identified by the author, had little impact on the final outcome. It was significant that in a selection committee of three, two were accountants. In the author's experience, this was not exceptional.

Requirements for a New Approach to IT Investment Appraisal

A time of transition

There are rare occasions, perhaps as rare as two or three times in a millennium, when society undergoes a change which is so profound and rapid that in the space of a few decades it exceeds that which occurred over the preceding centuries. This is described by Drucker. "Within a few short decades, society rearranges itself - its worldview, its basic values, its social and political structures, its arts, its key institutions. Fifty years later there is a new world. And the people born then cannot even imagine the world in which their grandparents lived and into which their own parents were born." (1)

The invention of the printing press by Gutenberg in 1455 illustrates this. By enabling books to be printed it resulted in an explosive growth in the dissemination of knowledge, rapid and wide advances in education, literacy and scientific discovery. Fifty years later America had been "discovered", and Martin Luther had launched the Reformation. Geopolitics and society had changed beyond recognition. The invention of the steam engine in 1776 set in train the Industrial Revolution, which decimated the workforces in traditional industries such as boatbuilding and agriculture.

The following outcomes appear to be common to all such transitions.

(a) Economic entities and professional activities, fundamental to the old order, in the new order either disappear completely, or incur a vast diminution in importance, for instance the impact of the steam engine on horse-based transport and on the canals.

(b) New economic entities and professional activities emerge and become paramount. Engineers and the factory were unknown before the advent of the steam engine.

(c) The scale of political and social change matches that of economic change. The social, political and economic picture of Europe in 1825 was utterly different to that of 1775, as was that of the early sixteenth century to what had applied fifty years earlier.

(d) During the course of the transition, awareness of the significance of the changes is limited, understanding even more so. Many of the key expositions have only appeared at the end of the phase.

There is every reason to believe that the latter years of the twentieth century have witnessed the onset of another epoch-forming phase. The political evidence is underlined by the breathtaking collapse of Communism, the speed of which was unimaginable a little more than a decade ago. With equal suddenness, seemingly impregnable corporations such as IBM, Pan American and General Motors either collapsed, or began to incur unimaginably large losses. Yet it was as recent as 1975 that a respected commentator like Rex Malik could make a seemingly plausible argument that IBM was set to take over the world! (2) Company structures transform from the hierarchical to the flat, shedding vast numbers of employees in the process. As unemployment grows, and those in employment adopt new values and attitudes to work, trade union power ebbs away. Traditional manufacturing industry goes into decline, while services and knowledge-based industries grow. The collapse of trade and tariff barriers brings in its wake opportunities but also casualties. The tried and tested methods of the past no longer work. In desperate attempts to adapt, companies take measures inconceivable only a few years previously, engaging in mergers and take-overs, or even collaboration with deadly rivals - but only those who recognise what Drucker calls the 'decisive factor of production' are able to adapt. This 'decisive factor of production' has been identified by the most incisive minds of our age as information. We are at the beginning of the Information Age.

Tapscott and Caston identify information and information technology as central to these developments. "Faxes provide students demonstrating in Tienanmen Square with information about what is happening in their own country.. thousands of networked personal computers become key battleground weapons (in the Gulf War). Global communications networks energise the metabolism of world commerce and move us inexorably toward Marshall McLuhan's global village". (3).

The IT productivity paradox

This realisation has contributed to the explosive growth in the expenditure on information technology (IT) - IT being defined as computers, telecommunications, and the related software. This expenditure has grown by a compounded rate variously estimated as between 200% and 350% during the 1980s, (a rate far in excess of normal business growth) and now amounts to 50% of all new capital expenditure in companies in the US. (4). US firms are expected to spend $200 billion on IT in 1993, (5) while the comparable figure for Germany tops $50 billion.(6). In the US in 1992 the computer equipment and services sector was larger than automotive steel, mining, petrochemicals and natural gas combined - a truly staggering realignment in the profile of industry.

Over the same period, white collar productivity (the focus of the bulk of IT expenditure) has risen by about 15% in manufacturing industry, and 3% in the services (7). Some studies suggest that at least 20% of expenditure is wasted, and that 30-40% of IT projects realise no net benefits, however measured (8). The situation is therefore one in which a huge and growing investment in IT is failing to provide anything approaching a satisfactory return. The widespread disenchantment with the returns from IT among business managers should not therefore be surprising (9). This is exemplified by the oft-repeated quote of a leading American executive : "I only know two things about IT - it costs too much and doesn't work". The point should be made that the overall lack of payback demonstrated masks the many outstandingly successful strategic and departmental applications which have been recorded over the same period. Among these have been a spreadsheet which made $76 million on for a chemical company (10), and an executive information system which generated additional income of $100 million for Phillips Petroleum in the US (11). This underlines, not only the extent of the failures, but the potential business benefits arising from an effective evaluation framework.

Management appears to have recognised the importance of IT, but just as the old solutions no longer supply the answers in overall business terms, existing approaches governing investment practice for IT are also failing. This is consistent with our being in the state of transition to a new epoch. Flinging computing power at the current business problems under the old parameters is doomed to failure, as was the attempt to breed bigger and faster horses to overcome the challenge posed by the steam and internal combustion engines. Managers need to apply a radically new approach to address the problem.

But will a new approach be applied?. The picture today is not encouraging. For instance a study by Peat Marwick in 1989 shows that 75% of companies lack any effective evaluation procedures for new IT initiatives. (12) The author's personal experience over many years as an IS Manager with the Ford Motor Corporation and as a consultant, bear out the findings of researchers in this field, which suggest that the problem stems from the following:

- the widespread use of traditional cost benefit analysis techniques, which, on their own, lead to inadequate and misleading outcomes (13).
- the common perception that such techniques are inadequate, leading to a lack of confidence in appraisal techniques in general (14).
- the perception that newer, IT-specific approaches are too time consuming or com plex.
- the slowness with which the accountancy profession appears to be adapting to the new challenges(15)

Up-to-date research by the author with four participating organisations largely confirmed these findings. What appears to be called for then is a convincing and practicable framework which accommodates the new business paradigm. This calls for the following characteristics:

- Flexibility to accommodate different investment categories, rapid technology and business change, while maintaining adequate levels of consistency.
- Rigorous and convincing methods which do not place undue demands on man agers' time and data resources.
- The presence of guidelines for moving to the IT organisation of tomorrow, while optimising current investments in IT.

Such a formulation will not be easy to identify or implement. Change will always be resisted, vested interests will defend their positions with great tenacity, and use a variety of plausible stratagems to thwart progress. Even organisations and professional groupings (such as the accountancy profession, referred to above) whose interests lie in identifying such a formulation find the scale of change difficult to accommodate. The slowness with which the accountancy profession has responded to the challenges posed by developments over the period under review underline this. Despite the fact that IT investments now account for about 50% of all new capital expenditure, and that such expenditure is clearly not generating a satisfactory return, traditional accountancy investment appraisal techniques still dominate the evaluation process. (16) That profession has also failed to come to terms with Balance Sheet issues of major importance, such as depreciation of IT equipment, and the capitalising of IT- based assets such as software developed in-house and information banks.(17)

The Limits of Conventional Approaches

Before bringing forward the proposed framework, the limits of conventional business and IT approached should be clarified. Traditional business organisational structures, the so-called "command and control" paradigm, were (and still are) hierarchical, task as distinct from process oriented, internally focused and inflexible. Decision making is slow and cumbersome. These characteristics are the direct opposite of what is required in today's business environment, which calls for flexibility in all areas of the business, a customer-focus, with empowered staff operating under a team and process-based organisational structure.

Such a transformation will not be accomplished by tinkering with existing structures. Fundamental change will be required. Numerous models have been proposed to facilitate organisational redesign, for example, Senge's *Learning Organisation*, Quinn's *Intelligent* Enterprise, Rothschild's *Bionic* Firm, and others.(18) It is not proposed here that there is a "right" model as such for every organisation, but for the purpose of this exercise that of reengineering, or business process redesign (BPR), as developed principally by Mike Hammer will be applied. BPR has achieved widespread recognition, and the concepts and terminology would appear to be generally well understood. The main issue is not the specific model, rather the concept that fundamental change, or some form of "business reinvention" is required. Some of the most dramatic turnarounds in business history in recent years have taken place at Ford, Xerox and Kodak. The improvements accomplished in these companies could only have been achieved by applying business redesign techniques rather than conventional remedies.

An exact parallel can be made with IT. Irrespective of the computing power applied to make existing processes run faster, few if any would have been fundamentally improved in the absence of process reengineering. In the case of Ford, for instance, executives calculate that even with greatly enhanced computer support for the existing vendor payment process, headcount savings would have been in the region of 20%, rather than the 80% achieved by reengineering (19).

Therefore, it is suggested that effectiveness in IT, and thereby satisfactory returns on IT investment, cannot be fully achieved by automating existing processes, only by reengineering them.

Achieving Benefits Through IT

(a) Change the Mindset

The first requirement is for a changed mindset for IT staff, who have been conditioned to approach projects from the perspective of existing processes. In fact, in the author's experience with Ford in the 1970s , the word "automate" was used when referring to a systems development project, thus embedding the concept of automating existing processes in IT thinking . Such a mindset remains widely prevalent.

This new mindset will provide the foundation upon which IT staff can redesign and reengineer new business processes rather than take the traditional route of automation. IT attributes such as analytical minds, structured methodologies, understanding information flows, and project management skills still represent an invaluable contribution to a reengineering project

(b) From Deductive to Inductive Thinking

Traditionally, most business problems, (especially those related to IT) have been addressed by way of deductive thinking. That is, the problem is defined, possible solutions are explored, and the optimum solution is selected on the basis of a variety of criteria. Inductive thinking turns this approach on its head, in that it calls for the capacity to envisage the capabilities of a particular technological development, and then seek the business problems it might address.

This may appear to be breaking the golden rule of systems development, that solutions should be business rather than technology driven - the so-called "solution looking for a problem" syndrome. Whereas this is undoubtedly true for applications related to conventional DP or automation, it becomes valid, indeed a requirement, in the context of reengineering. This is because certain redesign possibilities will become apparent only if seen in the light of what Hammer and Champy call the "disruptive power of technology" (20). They go on to underline both the difficulties in, and importance of "recognising the new, unfamiliar capabilities of technology instead of its familiar ones". This difficulty stems largely from the propensity of organisations to view technology through the prism of their existing processes and practices.

An example often serves best to illustrate the concept. One of the best known relates to the invention by the Xerox Corporation of the photocopying machine around 1958. Believing it was not adequately resourced to undertake the marketing of the product, it offered the patents to IBM, which commissioned a leading American firm of consultants to undertake a market research study. The study was postulated largely on the basis of the copier replacing the use of carbon paper (the standard copying mechanism at the time), and was no doubt carried out efficiently. The conclusion, undoubtedly correct, was that even if 100% of the market for carbon paper were to be captured, the proposal would not be commercially viable. IBM rejected the chance to enter the photocopying business. It is clear, with the benefit of hindsight, that the new technology created a market, one that was not envisioned at the time. It created a market, as by enabling many people to simultaneously use and retain a copy of the document, a whole new way of doing business was opened up. Inductive thinking, or technology visioning, properly applied by IBM at the time, may have identified the vast potential for the technology. Instead, by viewing it through the prism of existing processes, the opportunity was lost (21).

(c) Provide an Appropriate IT Infrastructure

Given the special requirements of business redesign, it is suggested that the following characteristics should underpin the IT infrastructure

Flexibility: The capacity to develop an IT solution quickly is an essential element of many reengineering initiatives, and this in turn calls for a flexible and responsive IT architecture. One heavily dependent on mainframes and/or legacy systems is unlikely to provide the appropriate degree of flexibility.

Robustness: Business process reengineering will often impose significant strains on an IT infrastructure, as, of its essence, process redesign is likely to entail change of a fundamental nature. New or untried operating or database systems, an assortment of networks or communications protocols, low levels of integration between applications, inadequate security and backup procedures all undermine the robustness of an infrastructure. Any of these elements could give rise to serious problems if challenged by a fundamental business redesign initiative.

Openness: The capacity to look outside the confines of the firm (primarily to customers and/or suppliers) often provides the best reengineering opportunities. An open architecture and an adherence to industry standard communications protocols are key features in this regard.

The following framework will be based on the proposition that a comprehensive IT investment appraisal can only be undertaken when the evaluation is based on five *perspectives*. Even though it is only one of the five *perspectives*, reengineering (in the broadest meaning of the term) has been given particular mention primarily because of its omissions from every IT investment appraisal framework the author has studied. It is essential because the competitive pressures of today's business environment, together with the rapid rate of technological change, have rendered traditional models of business organisation obsolete. Attempts to improve the performance of this model, even when enhanced by IT, have resulted in only marginal improvement, and have contributed to the poor performance by IT in terms of investment returns. Only by reengineering operations around processes rather than tasks can this dilemma be resolved, but success will depend heavily on an appropriate IT infrastructure which should be flexible, open and robust. IT must be seen, not only as an essential element in achieving this objective, but its powers must themselves be applied as a catalyst for change. This in turn provides the mechanism to finally deliver on the long-promised payback from IT, and as such must represent an essential element of any investment appraisal technique.

The Framework

Definition of terms

Perspective: The highest level evaluation criterion.
Category: Each perspective will be represented by a number (usually between three and five) categories.
Weighting: Each perspective will be allocated a weighting value out of 100. In the example which follows, the Strategic Alignment perspective is allocated a weighting of 28, composed of values for categories Importance of IT, Liquidity and Market Turbulence of 5, 15, and 8 respectively.
Scoring: The extent to which the proposed investment addresses the requirements of the five perspectives will be represented by a score from the range 0 to 10.
Element: The scoring will be based on a number of elements for each perspective. In the case of Strategic Alignment, for example, one of the elements upon which scoring is based is Timeframe. The extent to which the timeframe to implement the investment proposal aligns with business objectives will determine the score.
Probability: The scale of potential benefits or risks will vary according to the laws of probability. Accordingly each score will be adjusted by a probability factor, denominated in the range of 0.1 to 1.0.
Adjusted score: The original score adjusted by the probability factor.

The proposed framework draws on some of the Information Economics concepts developed by Parker and Benson (22), which provide tools to bridge the business/technical chasm, and which evaluate IT investments by way of weighting and scoring. It is almost a truism to say that business rather than technological considerations should drive investment decisions, but it is equally true to say that the gap between the business managers and technology professionals remains wide. It is essential therefore for any proposed solution to provide a *language* which transcends this gap, enabling both sides to address issues both comprehend, in a format with which both are comfortable. This is no easy task, and the problem is accentuated by what the author has found to be a reluctance on the part of management to allocate a proportion of their time which reflects the cost and potential business impact of IT investments. However, the scale of IT investment (plus the lack of payback) and its importance in positioning the firm for challenges of the latter part of the 1990s now render it essential for management to accept their responsibilities. A framework which is not unduly demanding on time would facilitate this.

The Primary Perspectives

The basic assumption underlying the framework is that all investments in IT should be evaluated in terms of five primary perspectives, the significance of each varying according to the particular project. These perspectives are:

Strategic alignment: alignment of IT and medium to long term corporate objectives.

Strategic alignment, in this instance defined as a state of harmony between business objectives and the systems that support them, has been an issue of leading concern for IT executives in recent years (23). The causes have been the growing importance of IT in terms of business strategy, and the increasing difficulty in achieving alignment. This difficulty in turn stems from the increasingly rapid rate of change in both business and technology, and the emergence of technology as a catalyst for business change in its own right.

Payback: direct value, such as cost savings, revenue enhancement, better management information.

This has been the most widely applied perspective used up to now, and has been commonly associated with cost/benefit analyses (CBA). As has been suggested earlier, in terms of assessing business benefits, CBA on its own provides a very limited perspective. Nonetheless, the possibility of direct financial benefit should play an important role in any investment decision. Systems which provide such benefits as enhanced management decision support, and better market intelligence, although perhaps not directly quantifiable in terms of business value added, would also come into this perspective. In determining the level of business value added, it is important to take into consideration not just the benefits, but possible negative factors, such as training or staff disruption.

Process redesign: enabling of business reengineering or process redesign.

As has been demonstrated earlier, it is no longer sufficient to evaluate new systems exclusively in terms of meeting specific business requirements. The capacity to enable new ways of doing business and/or to redesign business processes has to be a consideration for each new project. One of the most intractable problems associated with reengineering efforts has been the profusion of "legacy systems", which embed existing work practices in their software. It follows that failure to evaluate new projects in terms of their reengineering impact may not only ignore major potential benefits, but could result in an inhibitor in future reengineering initiatives.

Architecture: support and alignment with the corporate IT infrastructure.

For this purpose, the IT architecture is defined as the computers, networks, databases, and related software which make up an organisation's IT capability (this may not be everyone's definition). The issue of architecture is assuming growing importance, as more and more functionality is built into the operating systems, and as the move to multi-vendor sites gathers momentum. Whereas these developments bring with them a range of advantages, they have also given rise to a situation today where a profusion of incompatible software, hardware and communications platforms co-exist within single organisations(24). Even the smallest IT investment therefore has an impact on the architecture, for better or worse.

Risk: all potential risk exposure, such as technical, organisational and financial.

The poor return on IT investment has already been cited, and everyone has a favourite disaster of cosmic proportions to relate, such as those at the Wessex Water Authority and the London Stock Exchange. In the light of this, one might have expected that the issue of risk to have played a major role in IT investment appraisal. On the contrary, all evidence to hand suggests that formal risk assessment is applied in only a small minority of organisations, and the methods applied often miss out on crucial aspects.

It is proposed therefore that these five perspectives provide a comprehensive framework for management in evaluating IT investments in the 1990s. All perspectives are linked - indeed it could be said that there is a degree of overlapping. This suggests that all should form part of each investment project to be evaluated.

Weighting

Clearly, the relative importance of these perspectives will vary between organisations, between projects, and indeed may well vary for the same project over time. Nonetheless, if the evaluation is to be realistic, some form of weighting must be applied. For instance, a company with severe cashflow problems is likely to assign a high weighting to *business value added* (particularly direct cash savings), and to assign a low weighting to *infrastructure.* By way of contrast, a financially strong company, seeking to position itself for future expansion, would be likely to reverse these weightings.

As the weightings will effectively reflect an organisation's values and priorities, it is essential that a broadly based team, incorporating senior management, IT staff, and users, be brought together to define the relative importance assigned to each perspective. The author's experience shows that even managers in the business domain will often disagree fundamentally on what are basic objectives. If business managers find difficulty in agreeing on business objectives, so much the harder it must be for them to reconcile business objectives with IT managers, and hence identify appropriate solutions. This underlies the difficulty in achieving agreement which crosses over to technical managers. The framework provided below details a series of sub-components for each perspective which can be weighted separately. In this, the objective is not so much to achieve numerical accuracy, rather to provide a structure whereby the various team members can, by way of discussion and other forms of communication, achieve a deeper understanding of each other's objectives and problems, and a mechanism whereby these can be formally reflected by way of weightings. The importance of the role senior managers can play in this process cannot be overstated.

The concept of weighting suffers from some drawbacks, not the least being the subjective basis upon which the weights are formulated. Given the changing nature of the impact of IT on business, and the difficulty in establishing causal relationships between IT and business performance, an informed subjective approach is almost unavoidable. This problem is minimised when top level management provide leadership in establishing a strong corporate culture, and decomposing from this a series of management critical success factors, or *corporate imperatives*, as defined by Vincent (25). It would seem to be self-evident that the *exercise* of having a broad cross-section of managers attempt to arrive at a consensus on corporate imperatives, and the assignation of a relative order of importance, must in itself be of value.

Scoring

The proposed scoring mechanism envisages the assignment of a number of scoring categories to each perspective. These may be industry or company specific, and are not restricted by number. However, it is not envisaged that the categories detailed below should be significantly altered. The score is assigned on the basis of the extent to which the proposed system meets the objectives of each category on a range of 0 to 10.

The issue of probability must also be considered. Whereas this adds another dimension to a process which sets out to be simple, there does seem to be a requirement. The system under review might for example, justify a high score on the basis of its capacity as a reengineering enabler. Process redesign in turn may have been assigned a high weighting, which would result in this element having a very high positive impact in terms of the overall evaluation. However, if there is a high *probability* that the reengineering capacity of the system will not be applied, due to vested interests or whatever, it seems logical that the score should be modified to reflect this. One alternative is to address the issue under the risk *perspective*, i.e. that the probability of non-acceptance constitutes a specific risk and should be marked down accordingly. Information Economics adopts this approach, but it does have the drawback of either curtailing the number of elements which can be addressed under *risk*, thereby weakening the analysis, or alternatively, to include all the elements under risk, would seem to achieve no useful purpose.

Summary and conclusions

Myriads of considerations impact on the field of IT investment appraisal, each of which could justify a paper in its own right. As such they are beyond the scope of this paper, although they do form part of the author's research. This paper distils some of the key elements, and seeks to capture them in a framework which addresses the circumstances of the new business environment. This environment has derived in large part from the rapid rate of technological change, which has in turn given rise to the need for new ways of evaluating investments in IT. These will have to depart in large measure from the finance based criteria used up to now. The new criteria will of necessity contain a significant component of unquantifiable or "soft" variety. To managers accustomed to "hard" information, such a process may lack credibility, but as shown, so-called "hard" data is not only becoming increasingly inappropriate for IT investment appraisal, but more insidiously, focusing on such data can give rise to dangerous illusions of accuracy. The role of business managers in achieving IT payback will be crucial, and the proposed framework attempts to provide managers with a tool which goes some way towards pulling together the disparate elements, and proving an alternative set of values to those of the purely financial variety.

The framework will need to be adapted according to the organisation and the project being evaluated. It should be seen as a *continuing process*, to be amended and updated as conditions change. It is expected that over time, as management experience is built up, consistency and accuracy will be improved. The approach does not attempt to be prescriptive, and does suffer from limitations. One common to all methods applying subjective judgements is the risk of influence by factors such as lack of understanding or vested interests. Additionally, the research to date has demonstrated the difficulty in achieving consistency throughout the process. A more serious drawback relates to the possibility of a high score "burying" a single, potentially fatal, drawback. A mission-critical application could, for instance, be based on a newly introduced operating system and hardware, thus carrying a perhaps unacceptably high risk exposure. The potential benefits could however result in the proposal achieving a very high score, masking a potentially fatal downside.

The exercise should however be worthwhile if it does no more than co-ordinate thinking, educate, and bring home to management elements of risk and opportunity not heretofore identified. Furthermore, by in effect forcing management to address issues such as process redesign and architecture it introduces essential investment elements for today's environment.

References

[1] Peter F. Drucker *"Post-Capitalist Society"*, 1993

[2] Rex Malik, *"And Tomorrow, The World"*, 1975

[3] D. Tapscott and A. Caston, *"Paradigm Shift"*, 1993

[4] Peter G.W. Keen, *"Shaping the Future"*, 1990

[5] "Squeeze Play" *Computerworld*, April 19, 1993

[6] "How European IT Stacks Up", *Information Week*, March 15, 1993

[7] Figures originating from Morgan Stanley, quoted by Ian Dewis of the Cranfield IT Institute in a paper entitled *"Managing IT Investment for Business Benefit"* [proceedings from seminar "IT Investment Appraisal" London, 18/02/93]

[8] Willcocks & Lester *"Evaluating the feasibility of Information Technology Investments"* Oxford Institute of Information Management, 1993.

[9] *Computerworld, ibid.* "Fewer than half [48%] .. said they were getting their money's worth from their organisation's IS spending".

[10] N. Dean Meyer, and Mary E. Boone, *"Information Edge"*, 1989

[11] Proceedings form *"EIS '93"* Business Intelligence Conference, London, June 1993, also Paul A. Strassman *"The Business Value of Computers"*, 1990

[12] *"Evaluating Investments in IT"* [Farbey, Land, Targett] A footnote to this paper refers to a series if triennial surveys undertaken by the MIS Research Centre of the University of Minnesota and the Society for Information Management. "In surveys throughout the 1980s the issue of 'IS Effectiveness Measurement' ranked in the top ten in the lists of concerns [Brancheau and Wetherbe, 1987], but by the recent survey quoted [1989] the issue had dropped to 16th. The authors of the survey speculate that the principle reason for the drop on the issue. However, a related issue *'Making Effective Use of the Data Resource'* has risen to second place. Perhaps what has changed is the way the problem is perceived".

Schwartz and Sassone report that they have found many firms "which have tried up to a dozen different measurement schemes to demonstrate the value of a pilot office system project. Yet many firms appear to be no closer to proving the value of their systems than when they started". A.Perry Schwartz and Peter G. Sassone, "Is Management Technology Living up to its Promise?" *Business Forum*, Fall, 1984.

The Centre for the Study of Data Processing studied 1500 companies on their views and the important issues facing them. The topics of greatest concern demonstrated interest in linking information technology planning with business planning. However, their concerns about linking such planning with the results in the business area, such as profitability and business impact, were at the bottom of the list. [Quoted from *"Information Economics"*, Parker and Benson, 1988.

[13] Beat Hochstrasser and Catherine Griffiths *"Controlling IT Investment"*, 1991

[14] Keen, *ibid.*

[15] Case studies such as those mentioned are cited by Peter Bartram, *"Business Reengineering - The Use of Process Redesign and I.T. to Transform Business Performance"* 1992, and Hammer and Champy, *"Reengineering the Corporation - A Manifesto for Business Revolution"*, 1993

[16] Hammer & Champy, *ibid.*

[17] refs for senge etc.

[18] Hammer & Champy, *ibid.*

[19] Maralyn Parker and Robert Benson *"Information Economics"*, 1988

[20] The Butler Cox Foundation/CSC Index group found that respondents put it at the top of their list of concerns. [Research Report 86, *"Strategic Alignment"*, April 1992. A survey cited in a report from Computer Technology Research Corp. *"Information Systems Strategic Planning"*, June 1992, ranked this issue at number 4 in a list of 0 top issues.

[21] Keen makes the point that the explosive growth in the requirements for systems integration specialists would not have arisen had infrastructural ramifications been afforded appropriate importance at time of purchase. P.G.W. Keen, *ibid.*

[22] Michael J. Earl, *"Management Strategies for Information Technology"*, 1989

[23] David R. Vincent *"The Information-based Corporation"*, 1990

[24] Dmitris N. Chorafas *"Measuring Returns on Technology Investments"*

[22] Hammer & Champy *ibid.*

[23] Leslie Willcocks *"Information Management: The evaluation of information systems investments"* 1994

Appendix III

Quantifying End-user Benefits

The problems of end-user computing

Phase 3 of the Four Phases of Evolution in Chapter 3 described the explosive growth in distributed and end-user computing beginning with the introduction of the personal computer in 1981. This growth has continued to the present day, and some commentators estimate that the number of applications developed, and software packages purchased by end-users is beginning to match those developed and purchased by professional IT staff (1). This chapter went on to demonstrate how these developments gave rise to new and additional difficulties in evaluating IT investments, and in determining value added. The relative cheapness of hardware and software at end-user level masked a wide range of hidden costs which seldom show up in IT budgets. Charles Babcock (3) Editor of *Computerworld* described the problem as follows:

"There is the hidden cost for support - $6,000 or more per PC per year. There is the cost of networking. And a soon-to-be-released study from the Microcomputer Managers Association says there are hidden costs to moving to a graphical user interface. Making invisible costs tangible and keeping a realistic tab is the mark of a good manager. What is often forgotten however, is that savings gained should be tracked just as aggressively".

Quantifying end-user benefits

The research has shown that this latter consideration (tracking savings) has proven particularly difficult to resolve. Traditional interviewing techniques have been shown to be inadequate in identifying, and more particularly in quantifying, savings and other gains from end-users, particularly from managers, given the nature of their work.(3) Based on interviews undertaken in the course of this research, the following seven stage approach, which proved useful throughout the research, has evolved.

1. Preliminary information

As much preliminary information as possible should be gathered about the user's job and key performance indicators. These should ideally be derived from a number of sources, not just the individual. The sources could include the corporate strategic plan (assuming there is one), company annual reports, and departmental or management review meetings.

2. Opening the meeting

The research suggested that a heavily structured, questionnaire-style interview is unlikely to be fully effective. Better results were achieved when the effort was directed towards determining what the interviewee does, and what he perceives as the factors which determine success for him personally. Experience showed that this will not come easily, as individuals frequently provide "company line" or self-serving answers, or those that he feels the interviewer wants to hear. Therefore it is important initially that the interviewer expresses interest in the job in the broadest sense, and gives the interviewee adequate opportunity to discuss the job/project, and give his views freely.

Asking whether his job or department is afforded due recognition, or how he feels his or the department's performance could be improved can be fertile sources of information, as can a discussion on his likely career path. The objective is to gain an enhanced appreciation for what he believes his objectives to be, and to be in a position to evaluate whether these are in accordance with corporate objectives as determined earlier. Given the variety of jobs and the range of personality types, a structured questionnaire is unlikely to provide the requisite scope and flexibility. This is not to say that a certain structure should not underlie all interviews. Such a structure is necessary, but should be used more as preparation for the interview than in the form of a questionnaire.

3. Resolution of inconsistencies

Where an answer has been given which appears at variance with information received earlier (either as part of the preliminary investigation, or as part of the interview), a direct challenge was found to be inappropriate. A subsequent gradual raising of the same point via another route proved to be more effective. An example might be where both organisational objectives and the interviewee define "100% fulfilment of customer orders" as the critical success factor. However, the interviewer may have the perception that low inventory carrying costs may be what really matters. A more realistic response might then be obtained by redirecting the conversation onto, for instance, the pressures that apply in performing his tasks efficiently. A short discussion of this could be followed by a statement like "it must be very important, and very difficult, to keep down inventory carrying costs when you are providing such a high level of service". Given plenty of time and encouragement, he will probably reveal his real motivational factors more accurately.

4. Non-sequitors

The field research was plagued by the constant introduction of side issues and non-sequitors by participating managers. To this could be added potentially contentious comments, or remarks which could derail promising lines of inquiry. It was found that the potential problem can be avoided if the interviewer simply ignores the comment and continues literally as if nothing has been said. If the interviewee became particularly negative, silence while he spoke, followed by a careful acknowledgement (not necessarily acceptance) of his position, was found to be the best reaction.

5. Quantifying the benefits

Quantifying benefits in the realm of end-user computing, particularly when it relates to managers, is recognised as an unpromising task, with benefits generally being classified as of the intangible variety (see Chapter 7). Yet, as stated earlier, the scale of investment in these areas calls for the maximum endeavour to be made in seeking to firm up on the benefits where possible. Direct pressure on the user to quantify benefits was shown to give rise to defensiveness and a lack of frankness, or a retreat into vagueness. One of the most common reactions identified during the research is that when asked to specify the benefits of a new system, the response will be " better and faster information", possibly with the rider that it is impossible to quantify the value of such benefits.

Rather than focus in on the specific benefits, an approach which sought to identify *one specific benefit which would have been achieved with the system*, with a view to expanding this into identifying the full scope of the benefits. The following simulated dialogue, beginning with a response to the "better and faster information" reply, demonstrates a typical scenario:

Interviewer: "That must be useful. How does it specifically help you in your work?.

Some specifics may be provided, for example, sales quotations can be submitted earlier, and be more effective through the use of better information.

Interviewer: "I can see why you like the system. I wonder how often does this actually result in additional or better deals? For instance, can you recollect even one occasion in which the system made a difference, or were there close calls before the system was introduced when it could have made a difference?"

If no instance is provided, it can reasonably be assumed that the system is not providing tangible benefits, unless the extra time the user now has is being availed of by way of additional tasks, or enhanced decision-making capability (see below). The user is in fact more likely to name one or more instances where the system has, or could have, made a difference. Rather than seeking to quantify as this stage, the user should be encouraged to talk more about it, without undue prompting. This could be followed by a comment such as *"from what you say, there could have been other examples as well"*, and if appropriate, suggested possibilities could be advanced. In the discourse which inevitably follows, further possibilities may be identified.

Now is the time to attempt quantification of benefits.

Interviewer: "It seems you'll make great use of the system. Looking back, it seems that maybe up to five additional sales may have been made over the last year had you had it at the time. Would you think this is realistic?"

Clearly, this runs the risk of putting words in the user's mouth. The risk must be set against the need for quantification, and if the interviewer has established a reasonable degree of trust, should not present undue distortion.

It is now possible to quantify the profit potential of the additional sales (taking average margin per sale and multiplying it by the number of sales). This can be used for subsequent measurement on how the system actually performed. If the benefits are subsequently not realised, the process should be repeated along the original lines. The objective would not be to apportion blame, rather to learn from the process, and incorporate what was learned into future evaluations and proposals.

Refine quantification

As described earlier, benefits are often presented, especially by managers, as intangibles, frequently along the lines of 'faster information'. Receiving the information faster does not automatically translate into business benefit. An appropriate response would be *"how do you find that useful?"* This provides a sharper focus, and frequently, what seems to be a clear-cut benefit turns out to be no benefit at all, once the user has the time to think the process through by responding to the question. In the example quoted, it may turn out that getting the information faster has no practical impact on achieving the user's objectives.

Additional degrees of refinement can be achieved by focusing on the constituent elements of the claimed benefits. For instance, should the user say *"the system saves time"* it should be established, using the techniques described above, *whose* time and *how much* is saved, and *how often.* Again, it is essential that this be established without the introduction of a confrontational element.

A somewhat surprising finding in the research relates to the effectiveness of ignoring an unsatisfactory answer, and virtually repeating the question. This is particularly effective when the reply is long, rambling, or inconsistent. This is a somewhat risky tactic however. On one occasion, when mishandled by over-repetition, and when the answer had in fact been short and unambiguous, introduced a somewhat confrontational element which was counter-productive.

Cross-verification

Continuous cross-verification of the information given during the interview(s) is important, but this should be done tactfully. For instance, if, reverting to the example last described, the user claims the system *"saves time"* it has been found that, rather than asking *"what do you do with the extra time?"*, there and then, a more effective approach was to raise the issue at a later stage, ideally in a different form. This could be presented as *"do you find that the system enables you to do things now that you could not do before?"*. If the reply is in the negative, it does not necessarily mean that he had been wrong in claiming it saved time, or that he is wasting the time saved. A further question subsequently along the lines of *"have you found in any way that the system gives you more time to actually do the job better?"* can reveal the true benefits. In the case of an affirmative answer, a follow-up question such as *"That's good. Do you find yourself doing things now that you did not do before?"* proved useful. This may reveal definite benefits, or alternatively, that the supposed enhanced quality is largely in the user's mind. The principle is one of self-checking, without making it appear to be self-checking.

Hypotheticals

On occasions, asking the following hypothetical questions have been found to be informative:

(a) How exactly would the user manage if the system were taken away? Although this may appear to be repeating the same questions, the research has shown that new insights can be provided. It could indicate an inability to do the job, or even suggest that the job could be done quite well without it.

(b) Ask how much the user (preferably at manager level) would be prepared to pay for the forecast benefits of a system. This is a useful if somewhat unscientific means of determining a system's value. In terms of quantifying a system's worth, the value of a manager saying for example *"if the system gives me what the vendors say it will, it would be worth £15,000 a year to this department"* should not be underestimated, particularly when set against the other cross-checking techniques mentioned earlier.

4.3 *Summary*

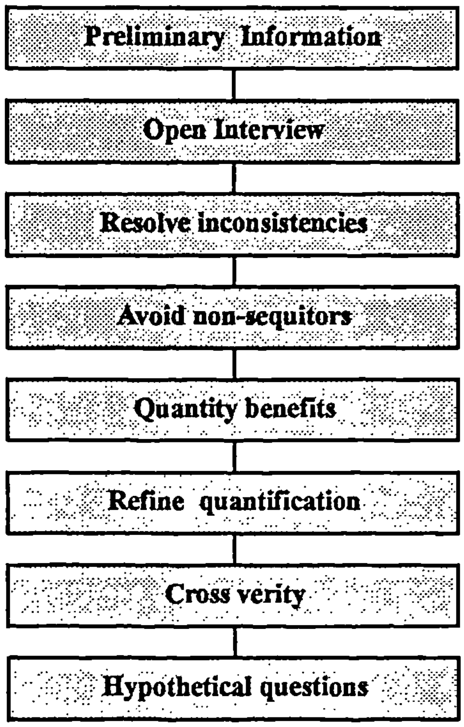
This seven point interviewing technique should not be regarded as an end in itself, rather as an added resource for determining system benefits. Results should be validated against other yardsticks, which will vary considerably between organisations.

The approach does have its limitations. It is dependent to a considerable degree on the knowledge and judgement of the users, the skills of the interviewer, and on the personality interplay between the interviewer and the user. Furthermore, it runs the risk of "leading" the leading the interviewee. However, given the extent of the difficulties experienced in quantifying end-user benefits, less than scientifically rigorous methods may have to be tolerated, especially in the light of the frequently amorphous and intangible nature of those benefits.

Clearly, the technique is not one which can be "learned" as such. It requires practice and experience for each interviewer to fine tune his or her techniques, and these will undoubtedly need to be tailored to adapt to different individual and organisational characteristics. Lessons learned from the exercises should contribute to organisational learning, and be incorporated into future appraisals of system proposals.

An important conclusion to be drawn from the research would seem to be that when seeking to establish how a user hopes to benefit from a system, do *not* ask him what he wants from the system! In a high proportion of cases this gives rise to unstructured, incomplete, or unrealistic demands. The approach should be along the lines of the seven steps defined: establish what the real business objectives of the user are, and then seek to translate these into systems functionality and quantified benefits.

Fig 1. **The Seven-Stage Approach to End-user Benefits Measurement**



Process Redesign Case Study: John Radcliffe Hospital

Introduction

John Radcliffe Hospital is an acute hospital located in Oxford. It provides a wide range of medical, emergency surgical and maternity services, as well as housing the teaching, library and research facilities for the Oxford University Clinical School. Faced with steadily increasing costs for health care, supplemented by an ideological commitment to cost-cutting in the public service, the early years of the Thatcher administration saw heavy pressure on hospital to introduce new administrative structures which would result in a more "business-like" approach to hospital organisation. A key element was to adopt the Clinical Directorate organisation structure, which would involve assigning control to clinicians in the control of resources. John Radcliffe Hospital responded to these developments by appointing a general manager to oversee what was in effect a process redesign exercise.

The first attempt

The hospital was positive about the proposed changes, but the initial results were not satisfactory. Six clinical directorates were set up, and senior clinicians were assigned to each directorate to act as co-ordinator for its activities and represent the directorate at hospital level. Regular meetings identified the key issues and much progress was made in moulding cultural attitudes - no easy task when operating with highly skilled professionals. Nonetheless, fundamental shortcomings were identified, in that whereas there may have been *de jure* power, there was no *de facto* power.

This arose because the underlying operational systems had not changed. The computerised information system was typically "legacy", in that reflected divisional boundaries, and was centred on the finance and administration departments. Clinicians therefore found great difficulty in deriving the information on which to allocate and control resources. In addition, while in theory administration staff were available for clinical directorate activities (as much of the administration previously undertaken on a centralised basis was now dispersed) in practice this did not happen. As the administration staff continued to report to the same managers, in the same centralised location, it is hardly surprising that a step change did not occur. Starved of practical resources, the directorates achieved relatively little on the ground change.

The second attempt

Learning from this initial effort, a three strand approach was then introduced to the project.

(a) Define the clinical work in process terms.

The meetings which took place during the first attempt proved to be useful here, in that the initial barriers to thinking in process terms had been breached. Dr. Chris Bunch, director of the resource management programme, told the author that the method adopted was to first define the process in simple, overview terms, then decompose it to the lowest practical level. This task was complicated by the clinical duties which all clinicians had to attend to. Many of the meetings had to take place very early in the morning, or late in the evening.

(b) Define an appropriate organisational structure.

Learning from the difficulties initially encountered, the objective here was to define the structures, resources, and support mechanisms required to support the defined processes. It was realised that tampering with existing structures would not work - a radical transformation was called for.

(c) Having defined the new processes and organisational structures, to develop new supporting information systems.

An appropriate IS support capability had been identified as crucial to the success of the clinical directorate initiative. Existing systems could not be adapted to meet the new requirements, so radically new developments were called for. Dr. Bunch told the author that the biggest single obstacle related to the practice of allocating funding on an annualised basis. Theoretically, no funding for systems could have been advanced when the new year's budget was announced, thus rendering planning and development most hazardous.

Achievements

(a) Defining the processes

In September 1990, six pilot areas were established to get the project operational. A lead clinician was identified for each area. A multidisciplinary team was established in each of the pilot areas, which, with the help of outside consultants, and building on the work already achieved, held a series of meeting in which the main processes were identified. The method was to ask each member to describe the services they provided in terms of discrete activities. Each of the areas defined between 12 and 20 processes. This exercise enabled the participants to obtain a much better feel for the resources they required, and were in fact consuming. The main objectives were achieved, in that the processes were identified, as well as the related resource requirements.

(b) Defining organisational structures

Significant progress was made in defining new organisational structures to support the process redesign initiative. The following new elements were defined:

Service Delivery Units (SDUs): This is the lowest level operational unit within the new structure, and is based on the provision of a specific *service*. Reflecting the reengineering thrust, SDUs are based not on *where* the activities take place, rather on the *process*. This departed from normal practice in hospitals. An SDU (for example, the cardiac services SDU) will have a management team comprised of a head clinician and a head nurse (although in the case of the clinician he/she is really more *primer inter pares*) which will be responsible for the allocation and use of resources. It is estimated that such management work takes up about two days a month each.

Service Centres: The high number of SDUs called for some kind of grouping arrangement, and this was done on the basis medical disciples which have a natural affinity. Six such grouping were identified. It was found that this new arrangement avoided many of the personnel and interdisciplinary clashes which characterised the original clinical directorates initiative. As with the SDUs, each Service Centre is managed by a clinician (Chairman) who spends about four days a month on management tasks.

Hospital Board: This is comprised of the Chairmen of the Service Centres, together with key hospital executives. At its monthly meetings it formulates strategy, and executive level decisions are made by this group.

(c) Developing new information systems:

In recognition of the fact that inadequate IT support systems were a major contributor to the initial lack of success, an Information Strategy Steering Group was set up, with Chris Bunch as Chairman. Bunch told the author that the new arrangements would have collapsed in a short time if operated under the old systems. It was decided to develop a totally new open, client-server architecture which will support the distributed processing requirements demanded by the new organisational structures. This is known as the "clinical workstation". The author has had the opportunity to evaluate the system, the development of which has been hit by uncertain funding. Certainly, in terms of information access and presentation it was far ahead of its legacy counterpart, although several bugs became apparent, and in the author's opinion, the existing hardware, database and network capability seems likely to suffer from severe performance degradation as more users are added and more information made available.

Lessons for process redesign:

(1) Getting everyone associated with the project to agree is an essential requirement. However, unless the logistics and other support are available, such initiatives will founder.

(2) The case again confirmed the importance of an appropriate ITarchitecture, in particular the relevance of open, client-server based solutions.

(3) Initial enthusiasm can often lead to opposition when the full ramifications of a reengineering exercise are felt by some of those affected (conversation between C. Bunch and the author).

(4) The annual budget approach adopted in the public service poses particular difficulties for systems development (difficult to project manage development in the light of possible large cutbacks).

Appendix V

(Company)

Rolling Mill Control System

Investment Justification Spec

Author:	**John Coffey, Michael Loftus, Patricia Verling**
Confidentiality:	**Level 3**
Access Control List:	**(Company) Steel Managers**
	NIMT Project Managers
Status:	**In Progress**
Date:	**1st June, 1995**
Revision:	**0.1**
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Replaces:

Revision History

Rev.	**Author**	**Date**	**Description**
Appr.			
0.1	JC,ML,PV	1/6/95	Document created.

Glossary of Terms and Abbreviations

Term	Explanation
NIMT	National Institute for Management Technology
MIS	Management Information System

Table of Contents

1. EXECUTIVE SUMMARY

This specification records the views of the authors on the scores which should be awarded to the Rolling Mill Control System under the following investment justification headings:

- Strategic Alignment
- Direct Benefits
- Architecture
- Re-engineering
- Risk

The weighting of the scores awarded by the authors needs to be completed by top management in (Company) to provide a complete investment justification against the business context in which (Company) operates.

Under the heading of Strategic Alignment, the system was examined against the following criteria (scores out of 10 shown in brackets):

• its capacity to enable (Company) to do business in new ways	(4)
• its adaptability to a changing business environment	(6)
• the duration of its implementation	(5)
• the clarity of its strategic objectives	(10)
• the impact of its introduction on the following:-	
o Staff Morale	(8)
o Corporate Image	(8)
o Customer Service	(9)
o Safety	(5)
o Quality	(5)

The strategic objectives of increasing efficiency and productivity are clear for this system. Staff morale and healthy competition will be boosted by the ready availability of performance information. Corporate image will be enhanced by the high-tech approach to process monitoring and customer service will benefit from improved production status information and better production planning. Hence, the awarding of very good scores under the appropriate headings above. Areas such as safety and quality will also benefit, but to a lesser extent.

The second heading under which the system was evaluated is titled "Direct Benefits". The specific criteria in this area are identified as the ability of the system to achieve the following:

- displace current costs or avoid future costs (10)
- make better use of existing and future investments (10)
- handle increased volume with similar staff numbers (8)
- create additional revenue (10)
- facilitate links with customers and/or suppliers (10)
- enable initiatives by competitors to be offset or emulated (3)
- facilitate product differentiation or new product introduction (8)
- reduce errors, re-submissions and re-runs (8)
- improve management control (10)
- provide management time savings (8)

This system scores very well under the heading of direct benefits. It will help Mill management strive for improved productivity and efficiency with consequential improvements in revenue generation. It will make full use of existing investment in PC and PLC technology. Customer service will be better supported through the ready availability of production information. The production of new products will more readily monitored and management control tightened.

The third category of evaluation is "Architecture" i.e. the information systems and networks used to support the information management requirements in Irish Steel. The following criteria are used to evaluate the system under this heading:

- impact on other applications (8)
- consistency with existing and planned architecture (5)
- support for future applications (5)

The system will have a very positive impact on other applications by making accurate information available to areas such as Shipping, Purchasing, Production Planning and Sales. Future applications which require a more detailed approach to process reporting will be easily catered for. The consistency of the system with existing and planned architecture was awarded a medium score as the Sheerness system has yet to be appraised.

The fourth category of system evaluation is "Re-engineering" i.e. the ability of the system to cope with and assist in changing work practices and processes in the future. The following criteria were used to evaluate the system under this heading:

- provision of greater flexibility in work practices (5)
- embedding of existing work practices (8)
- facilitation of process approach to business (10)
- capacity for modification (5)

On balance, this system will add to (Company) capacity to re-engineer in the future if required. The ready availability of Mill information on a plant-wide basis coupled with the process insights which should be gained as a result of system usage will certainly support the process approach to business and highlight areas where work practices are faulty. The capacity for modification was awarded a medium mark on the basis that the Sheerness system has not yet been formally appraised.

The final evaluation category is "Risk". The criteria encompassed by "Risk" cover the most common reasons for IT project failure and are listed here.

- Project scale (7)
- Vendor reliability (2)
- Platform stability (2)
- Technical risk (2)
- Employee and management ability, attitude and availability (8)
- Top management support (10)

The system scores relatively poorly under the heading of "Risk". There are few, if any, problems in the areas of top management backing, employee support and project scale. However, questions must be asked of the ability of Sheerness to offer system support at the level required in (Company). Recent reports from Sheerness indicate that the current system is being substantially modified, further reducing confidence in its stability.

The following sections of this report show the evaluation results in detail.

2. STRATEGIC ALIGNMENT	Score
Could it enable new ways of doing business? This system is geared more towards refinement of the current process rather than supporting a new process. It could be easily adapted to monitor new processes.	4
Can it be easily and quickly adapted in the event of change associated with today's business environment? This type of system can be quickly adapted to measure new parameters of interest.	6
Is the timeframe acceptable? Long timeframes increase the likelihood of deviation from corporate objectives. The timeframe has yet to be clarified and depends to a large degree on the ability of Sheerness to modify & install the system in (Company). A "medium" score is awarded in these circumstances.	5
Are strategic goals clear and consistent? If not alignment will be difficult irrespective of the value of the system. The purpose of the Rolling Mill Control System is to allow Rolling Mill management increase efficiency and productivity through improved process control.	10
Impact on staff morale? - higher-tech environment, ownership (pride or resentment), reduction in boring or repetitive tasks, more pressure due to lack of confidence. Better information available to operators on Rolling Mill performance should encourage clear focus on process improvement and encourage competition.	8
Impact on corporate image? Positive impact - real-time and historical process control informa tion readily available demonstrates management commitment to continuous improvement.	8
Impact on customer service? Should make Rolling Mill production more predictable, thus ensuring that supply to customers is as smooth as possible and mill slippage is minimised.	9
Impact on safety? The insights provided by the system will allow management improve plant reliability and availability. This, in turn, will lead to a reduction in accidents.	5
Impact on quality? A positive impact. Will help reduce the levels of non-prime material through tighter process control.	5

3. DIRECT BENEFITS

	Score
Does it displace costs or avoid future costs? Will assist Rolling Mill management in the attempt to reach the following targets: 2% increase in yield 3 - 4 Tonnes/hr increase in production Reduced energy consumption	*10*
Does it make better use of existing and future investments? Existing PLCs can be accessed and the data used to a far greater extent than is presently the case. Existing PCs can also be fully utilised for information presentation and analysis. Future PLC investment will also be fully exploited. Information from the Rolling Mill can be distributed to all other interested parties in (Company)	*10*
Does it handle increased volume with similar staff numbers? The system increases the probability of achieving mill output standards with no increase in headcount.	*8*
Does it create additional revenue? The achievement of production targets will increase revenue.	*10*
Does it facilitate links with customers and/or suppliers? Shipping and production planning will make full use of the accurate production information available from the system. Customers will ultimately benefit through improved status reporting on their orders and through improved planning.	*10*
Competitive response: does it enable initiatives by competitors to be offset or emulated? Plant configuration is of far more significance in this context than the proposed system.	*3*
Does it facilitate product differentiation or new product introduction? The system would provide valuable information on process performance during production of the new product.	*8*
Has it a capacity to reduce errors, resubmissions and reruns? The system will certainly reduce manual data collection errors. The system will increase the accuracy of management judgement on process issues.	*8*
Has it a capacity for improved management control? Improved management control is a key objective of the system through the provision of improved information capture and analysis facilities. This will lead to improved process control and understanding of Rolling Mill performance.	*10*
Does it provide management time savings? Management time spent on data collection and analysis will be reduced as the new system will automate most of this work.	*8*

4. ARCHITECTURE	*Score*
Consequential impact: does it have potential impact on other applications, (links, provide information sources or hardware functionality) The EIS will certainly extract information from this system. Shipping, purchasing, production planning and sales will also use mill information to the full.	*8*
Is it consistent with existing and planned architecture? The Sheerness system is currently envisaged as providing the basis for a solution in this area. However, latest news is that Sheerness are modifying their system to achieve improved performance. Implications of this for (Company) are, as yet, unclear. A medium score is awarded in the circumstances.	*5*
Does it form the basis for future applications? When the system is fully operational, mill management will certainly wish to refine reporting on relevant areas of the process and the system will facilitate this.	*5*

5. RE-ENGINEERING	*Score*
Could it provide greater flexibility in work practices? The more ready availability of mill information to a wider audience than currently, combined with an open door management policy will certainly facilitate greater flexibility in work practices through the increased debate and incorporation of new ideas.	*5*
Could it embed existing practices? The system would provide insights into the effectiveness of existing practices rather than embedding them in a concealed fashion.	*8*
Does it facilitate a process approach to business rather than reinforce function-based operations? The plant-wide availability of information from the Rolling Mill will certainly support the process approach to business while still allowing the Rolling Mill attain its specific targets.	*10*
Can it be easily amended to reflect new requirements? An analysis of the Sheerness system is required to answer this question. It is to be hoped that this system will be easily amended to reflect new reporting and analysis requirements. In some cases it will be dependent on the availability of suitable sensory equipment. A medium score is awarded in the circumstances.	*5*

6. RISK	*Score*
Does the scale of the project contribute to the risk of failure (0 = Yes, 10 = No)? This is a medium scale project and, as a consequence, is awarded a "slight risk" score.	*7*
Is the vendor reliable in terms of technical capability, financial strength? The ability of Sheerness to support the system in (Company) must be questioned. It is not clear at the moment if Sheerness has any experience of selling this or any other system to third parties in the past. On the assumption that this is Sheerness' first venture into software sales, a low score is awarded under this heading.	*2*
Are the hardware or software platforms stable and current? It is reported that Sheerness are currently modifying their system to use more modern and robust technologies. This indicates a lack of stability in the product at this point in time.	*2*
Are the levels of technical risk low? It appears that the Sheerness system has been specifically designed with Sheerness requirements in mind. On the assumption that this system is not in operation at any other sites, the level of technical risk involved in the installation of this system in Irish Steel is relatively high, due to the fact that it may not have been designed from this perspective from the outset.	*2*
Are employees and managers well equipped in terms of ability, attitude and availability for the task? Management and employees are keen to improve the performance of the Rolling Mill and will use this system to achieve this goal. It may be a little difficult to get some of the older workers to use the system to the full.	*8*
Is top management supportive? Top management is very supportive of the overall IT strategy and is keen to achieve the promised benefits in the Rolling Mill.	*10*

Perspective	Weight	Score	Adj. Score
Strategic Alignment	20	7	140
Payback	40	9	360
Architecture	10	6	60
Process Redesign	20	7	140
Risk	10	5	50
Total	100	34	750

Considerations for Weighting and Scoring under the Five Perspectives

The forthcoming investment appraisal exercise is based on evaluating the proposal under five different *perspectives*. Outlined below is a brief description of the five *perspectives*, together with a range of thought-starters which will assist you in performing a comprehensive review. Finally, in recognition of the fact that most organisations still see IT investments primarily in the context of providing a payback, this section concluded with a series of examples, based on actual events, which seek to show how limiting your review to Payback alone could give rise to a faulty investment decision.

Strategic Alignment: alignment of IT and medium to long term corporate objectives.

Strategic alignment, is defined as a state of harmony between business objectives and the systems that support them.. The inference here is that the linkage and support are seen in the medium to long term perspective. As IT becomes increasingly influential in every aspect of business, strategic alignment has assumed ever greater importance. It is also becoming increasingly difficulty to achieve alignment in the light of the increasingly rapid rate of change in both business and technology, and the emergence of technology as a catalyst for business change in its own right.

Considerations

mergers/acquisitions/alliances
suppliers moving up (becoming competitors - possibility of pre-emptive lockout)
better alignment with peaks and troughs
empowerment/reduced need for supervision
easier to recruit staff (system environment in wide usage)
improved self-image of staff (staff applying high-tech)
better corporate image
new geographical markets
reduced dependence on individual suppliers or customers
enhanced linkages with customers and/or suppliers
new distribution channels (agents, direct sale)

outsourcing (IT, distribution, telesales)
cash flow/liquidity
timeframe of strategy - the longer the more difficult the alignment
how clear are strategic goals
how adaptable is the strategy
reduced dependence on individual employees/customers/or suppliers

Payback Demonstrable value, such as cost savings, revenue enhancement, better management information.

This is the most widely applied and best understood perspective, and has been commonly associated with cost/benefit analyses (CBA). Used on its own, Payback can be of limited value in assessing business benefits. Nonetheless, the possibility of direct financial benefit should play an important role in any investment decision. Systems which provide such benefits as enhanced management decision support, and better market intelligence, although perhaps not directly quantifiable in terms of business value added, would also come into this perspective. In determining the level of payback, it is important to take into consideration not just the benefits, but possible negative factors, such as training or staff disruption.

Considerations

Direct cost savings:

staff reduction
overtime reduction
reduced level of h/w investment
reduced h/w or s/w maintenance
reduced use of consumable (e.g. stationery)
reduced inventories
reduced stock write-offs (obsolescence, scrap, etc.)
reduced travel costs (video-conferencing, e-mail, multimedia products)
reduced communications costs (e-mail)
improved stock security (e.g. better audit features)
improved cashflow
reduction in production sales or stock storage space
less need for specialised (i.e. more expensive) staff

Quality:

Reduction in backorders
fewer recalls/returns
fewer customer complaints
better response from customer surveys
fewer mistakes in invoicing/delivery etc.
reduced order/delivery time span
less reworking

Productivity:

higher sales per employee
more throughput per employee
fewer phone calls, memoranda, etc.
fewer queries (employees handle their own problems better)
better alignment with peaks and troughs
revenue earnings
reduction in or elimination of production or delivery bottlenecks
reduction in or elimination of non-value adding tasks
reduction order turnaround time
reduction in audit costs due to better information and/or documentation
faster access to information (not necessarily a benefit)
better on-line help to reduce support costs
less rekeying of data
less manual aggregating of data

Employee performance:

better quality of information (less wasted time)
reduced frustration
empowerment/reduced need for supervision
fewer occasions for mistakes
easier to recover from mistakes
reduced need for training (system more intuitive or provides enhanced functionality)
easier to recruit staff (system environment in wide usage)

more flexible working conditions
improved self-image (staff applying high-tech)
safer environment

Management performance:

better information
faster information
improved decision support capability
reduction in number of meetings due to better information

<u>Architecture</u> : support and alignment with the corporate IT infrastructure.

For this purpose, the IT architecture is defined as the computers, networks, databases, and related software which make up an organisation's IT capability (this may not be everyone's definition). The issue of architecture is assuming growing importance, as more and more functionality is built into the operating systems, and as the move from vendor-specific houses gathers momentum. Whereas these developments bring with them a range of advantages, they have also given rise to a situation today where a profusion of incompatible software, hardware and communications platforms co-exist within single organisations (18). Even the smallest IT investment therefore has an impact on the architecture, for better or worse.

Considerations

is the proposed investment consistent with existing/planned architecture
pre-emptive use of technology (workflow, EDI, on-line marketing, expert systems, electronic cash)
cater for increased volumes
capacity to link with third party products (spreadsheets etc.)
support new and/or additional applications (hardware, data, interfaces)
cater for new lines of business
degree of flexibility required
mergers/acquisitions/alliances
centralisation/decentralisation
outsourcing

Process redesign (Reengineering) the capacity to enable business reengineering or process redesign.

It is no longer sufficient to evaluate new systems exclusively in terms of meeting specific business requirements. The capacity to enable new ways of doing business and/or to redesign business processes has to be a consideration for each new project. One of the most intractable problems associated with process redesign has been the profusion of "legacy systems", which embed existing work practices in their software. It follows that failure to evaluate new projects in terms of their process redesign impact may not only ignore major potential benefits, but could result in an inhibitor in future reengineering initiatives.

Considerations

more flexible work practices
reduction/elimination of non-value adding activities (unnecessary checks)
does it facilitate a process approach
can it be easily changed to reflect new business requirements
capturing data more than once
can existing data be leveraged (B&L)

Risk all potential risk exposure, such as technical, organisational and financial.

In terms of IT investment everyone has a favourite disaster of cosmic proportions to relate, such as those at the Wessex Water Authority and the London Stock Exchange. In the light of this, one might have expected that the issue of risk to have played a major role in IT investment appraisal. On the contrary, all evidence to hand suggests that formal risk assessment is applied in only a small minority of organisations, and the methods applied often miss out on crucial aspects. Risk can take many forms.

Considerations

scale of project
definitional uncertainty
supplier technical or financial uncertainty
hardware new/untried or old/outdated
software new/untried or old/outdated

organisational preparedness
time frame - the longer the greater the risk
number of departments involved
support of top management

Some actual examples to support the need for the use of all five perspectives

- It is possible to buy an economical system which will do the job today, but will not accommodate future growth or changes in the business environment. If this happens, the 'cheap' system will have to be replaced, writing off the investment, and the whole implementation process will have to be gone through again. (The Strategic Alignment *perspective)*.

- It is possible to buy a powerful business application (say COMET running on Nixdorf 8870) for a very low price. This would give great payback, but the technology is going nowhere, leading to support and maintenance problems, difficulties in recruiting and keeping staff, lack of connectivity and integration, all leading sooner rather than later a totally new system with the original investment effectively a write-off in terms of money and time spent. (The Architecture *perspective*).

- A system can generate great labour savings and provide other benefits, but could mean your processes become inextricably embedded in the software. This is now being recognised as a potentially huge problem world-wide, with companies unable to redesign their processes to accommodate changing business conditions. One company was unable to introduce a major new product line on account of this. (The Process Redesign *perspective*).

- A system might promise major payback, but could be subject to unacceptable levels of risk. For example, the suppliers/developers might be financially insecure, the system might be based on new and relatively untried technologies, it might be excessively complex to implement and run - the list of potential risks is endless. (The Risk *perspective)*.

ORGANISATION 5

Benefits Management Study

September 17, 1996.

Prepared by: *Joe Flynn*
Michael Loftus
Tony Murphy

NATIONAL INSTITUTE FOR MANAGEMENT TECHNOLOGY
Business and Technology Centre, North Mall, Cork, Ireland.
Tel: +353-21-398398 Fax: +353-21-398544
Email: info@nimt.rtc-cork.ie
WWW: http://www.nimt.rtc-cork.ie

Glossary of Terms and Abbreviations

Term	Explanation
BMS	Business Management System
BOM	Bill Of Material
BPI	Business Process Improvement
BPR	Business Process Redesign
ECO	Engineering Change Order
ECR	Engineering Change Request
EIS	Executive Information System
FIFO	First In First Out
GRN	Goods Received Note
MIS	Management Information System
NIMT	National Institute for Management Technology
PDM	Product Data Management

Table Of Contents

1. EXECUTIVE SUMMARY

1.1 Introduction

This document defines the views of the authors on the scores which should be awarded to the Business Management System (incorporating Product Data Management functionality) under the following investment justification headings:

- Strategic Alignment
- Direct Benefits (Payback)
- Architecture
- Process Re-design (Redesign)
- Risk

During the IT Strategy consultancy project, the senior management team at ORGANISATION 5 assigned weightings to the 5 perspectives (averaged and rounded to the nearest 5% increment) which were as follows:

Evaluation Perspective	Management Weighting (%)
Strategic Alignment	30
Direct Benefits Added	15
Support for Reengineering	25
Conformance to Specific IT Architecture	15
Business Process Sensitivity to IT Risk	15
TOTAL	100

There were 3 business systems evaluated under the 5 perspectives - SAP R/3, Scala and Oracle Manufacturing / Financials. These systems have all been scored against the detailed benefits under each of the 5 perspectives and then these scores have been adjusted based on the weightings above.

1.2 Generic Business Benefits

The generic business benefits of implementing an integrated business management system include:

- Imposing control on operational disorder. This includes handling business activities consistently across the enterprise, centralising command and control, and forcing a process organisation structure.
- Improving efficiency and lowering the cost of doing business. This means upgrading processes to follow best industry practices and eliminating redundancies.
- Improved information management across the enterprise providing timely, accurate and appropriate information delivery for more effective decision making.

1.3 Specific product evaluations

1.3.1 SAP R/3

1.3.1.1 Benefits

- ***Tight integration***. R/3's applications are tied together into a disciplined whole. This means that all of R/3's modules — purchasing, payables, general ledger, etc. - work together instead of functioning as separate applications. This eliminates time-consuming and error-prone activities like matching invoices to purchase orders, vendor ID translation, and ledger posting.
- ***Single view of the business***. All applications in a single instance of R/3 share the same database. This eliminates the possibility of duplicate or redundant data - providing one consistent view of the information across the organisation. This allows R/3 to support consistent reporting and analysis across operational activities.
- ***Process orientation***. R/3 is based on a process model of business — focusing on activities like order fulfilment - and not on traditional functions like order processing, inventory management, and shipping. This approach forces attention on the end result — not on incidental, incremental steps. This can drive a streamlining of business processes.
- ***Rich functionality***. R/3 embodies proven best practices based on SAP's more than 20 years of experience supporting large companies. Initial releases of R/3 were derived from SAP's R/2 legacy mainframe products. R/3 is a comprehensive product embodying most business requirements.

1.3.1.2 Benefits - Other

- Out-scored the other business applications across the 5 perspectives.
- No. 1 business application world-wide installed in over 4,500 sites in 50+ countries.
- 6 out of the top 10 electronic companies use SAP R/3.
- Has a solid track record for successful implementations with large organisations
- Complete solution for all business functions within a given enterprise
- Ships with 160+ business objects and 1000 business processes per module which conform to global best business practices Ease of domestic implementation
- Fully compliant with ORGANISATION 5 architecture
- Workflow enabled
- Document Management functionality
- Approved PDM vendor list

1.3.1.3 Disadvantages

- High risk of implementation failure especially for multi-national organisations. Most R/3 implementations stretch the limits of both company and systems integrator project management skills. They are huge - in time to complete, number of organisations included, and number of people involved. Failing in an effort of this magnitude will distract the entire company for years. This applies in particular to organisations implementing across a number of locations.
- Missed new business opportunities. Corporate systems must thrive on change as IT reaches out to build new customer connections and as Commerce moves far beyond traditional EDI. R/3's tight integration and complexity can make it difficult for processes to change rapidly.
- Constrains scope for organisational initiatives. R/3's everything-including-the-kitchen- sink nature can cause atrophy of essential skills and capabilities. R/3 defines how things get done, takes massive resources to implement and run.
- Lock in companies to its proprietary ABAP4 technology.
- Licence costs @ IR£3,000 per user for up to 50 users. This does not include operating systems, networks, hardware, database or other licences.
- Implementation and consultancy costs can be expensive with an average ratio of 4 - 1 for spend on consultancy i.e. for every 100k spent on product licence 400k is spent on added value consultancy. These costs have now been addressed by SAP and new features in the latest release of R/3 have meant a reduction in the ratio to 2.5 - 1.
- Time-scales for implementation can be long due to nature of business process review

and sophistication of application

- Resources for SAP can be difficult to source due to ongoing demand for same. These resources are also very expensive.
- This product is not typically targeted at companies such as ORGANISATION 5.

1.3.2 Scala

1.3.2.1 Benefits

- International product installed in over 14,000 sites in over 20+ countries.
- Conforms to the ORGANISATION 5 IT architecture in principle but still awaiting roll-out of all products on NT.
- Fully integrated manufacturing, distribution, logistics and financial application.
- Market leader world-wide solution for small to medium size enterprises
- Delivers all the key business functionality required by ORGANISATION 5 as defined at present.
- Implementation time-frames are much smaller with full implementations done in 6 months period for companies such as ORGANISATION 5.
- Has a number of key clients in the electronic sector including Nokia, Memorex Telex, Erricsons, Dell and Oki

1.3.2.2 Disadvantages

- Scala is not process orientated i.e. re-enforces the functional view rather than a process orientation. It does not have a in-built redesign or workflow based architecture and so amendments to the software to reflect business process change require significant programming effort.
- No formal PDM approval process but have committed to integrate with one if required.
- Scala is still porting product to NT.
- Would not usually compete with SAP as both products are targeted at different markets in terms of project scale and costs

1.3.3 Oracle

1.3.3.1 Benefits

- Feature rich product with tight integration between all modules
- Facilitates process approach to business
- Supports Workflow technology
- International product installed in 4,000+ sites in over 15+ countries
- Strong international software developer
- Conforms to the ORGANISATION 5 IT architecture in principle but still awaiting roll-out of all products on NT.
- Complete solution for all business functions within a given enterprise
- Integrates with a number of PDM applications particularly Sherpa.
- Popular choice for many small to medium sized organisations.
- Lists Motorola as one its key users in the electronics sector
- Supports CAD integration

1.3.3.2 Disadvantages

- Weakness on functionality in some specific areas e.g. inventory (FIFO), Cash Management and Accounts Receivable.
- Time-scales for implementation can be long due to amount of up-front consultancy required to implement the application
- Costs for each module are IR£8,900 (approx.). A ratio of 3.5 - 1 in consultancy is then required to implement these. These costs do not include server or client licences.
- Costs for consultancy and implementation are high as are client licence costs
- This product is typically targeted at multi-national organisations or smaller organisations (1 location) who have a major commitment to IT.

1.4 Recommendations

In summary, SAP R/3 outscored the other products. It is a world leader in integrated client server applications designed and built to boost competitiveness within organisations. It has a high degree of integration and provides feature rich functionality to cater for manufacturing, finance, sales and distribution, human resources, CAD integration, document management and workflow requirements within ORGANISATION 5.

It is a powerful application in terms of business redesign capability and provides state of the art functionality to allow users to model, map and re-engineer their business processes as required. It also ships with workflow and document management functionality as standard. SAP may be prohibitive when costs, time-scales and resource requirements are taken into consideration but it has an excellent client listing within the electronics sector - 6 out of the top 10 electronic companies use SAP. Oracle is a close competitor of SAP and also delivers much of the above functionality as standard. This excludes such product as document management, workflow, system configuration tools, CAD integration and Engineering workbench tools. The Oracle product is not as mature as SAP R/3 and therefore, not as feature rich. Oracle is also expensive to implement. Scala is a powerful, feature rich and well respected integrated business application. It has many advantages over SAP and Oracle in terms of time-scales, ease of implementation and costs. Scala does not compete with these products normally and so comparisons between Scala and SAP R/3 / Oracle may be unfair. It does not contain the flexibility of SAP or Oracle particularly with respect to process orientation and reengineering capability. It does not support workflow, document management or CAD integration. These are all important building blocks in a flexible and adaptable business management system for a business such as ORGANISATION 5s.

In an ideal world SAP would be the obvious choice for ORGANISATION 5 in order to provide an enterprise wide integrated business solution. It is crystal clear that the rich functionality that SAP delivers as standard would justify the significant investment required. However, ORGANISATION 5 need to establish if they are capable of meeting the challenges that implementing SAP would present. Additionally, both SAP and Oracle would have considerable organisational impact and ORGANISATION 5 need to ensure that they are completely comfortable with the following issues before committing to either product::

- Will senior management provide the necessary time, commitment and backing to such a strategic project ?.
- Will the current ORGANISATION 5 personnel be in a position to utilise and capitalise on the online business critical information that SAP will provide ?.
- Are ORGANISATION 5 management currently equipped to identify the profound changes that such a product will have on work practices, business information, organisational structure and business processes within the organisation.

The short-listed products, if implemented effectively, will provide fundamental improvements to ORGANISATION 5s business performance. However, such improvements will only be achieved if the above questions can be answered in a positive manner.

2. MAIN REPORT

2.1 Strategic Alignment

Under the heading of Strategic Alignment, the systems were examined against the following criteria (scores out of 10 shown in brackets):

	SAP	Scala	Oracle
• Support for mergers / acquisitions / alliances	(8)	(8)	(8)
• Capacity to enable ORG 5 to do business in new ways	(9)	(5)	(8)
• Better corporate image	(9)	(6)	(8)
• The clarity of its strategic objectives	(10)	(10)	(10)
• Empowerment - reduced need for supervision	(8)	(8)	(8)
• Support move to new geographical markets	(9)	(9)	(8)
• Enhanced linkages with customers / suppliers / sub-contractors	(10)	(9)	(9)
• Cash flow / liquidity	(9)	(9)	(9)
• The impact of its introduction on the following:-			
, Staff Morale	(9)	(9)	(9)
, Corporate Image	(9)	(9)	(9)
, Customer Service	(9)	(8)	(9)
, Quality	(9)	(8)	(8)
Sub-total	(108)	(98)	(103)
Average	(9)	(8)	(9)

The strategic objectives of reducing time to market, improving customer service, increasing efficiency and productivity are clear for the BMS. The reduction in time to market will be facilitated by new functionality to automate ECRs, ECOs and BOM maintenance. This will deliver a significant reduction in the administration time spent on these tasks. Customer service will benefit from the availability of key customer and order fulfilment information as well as from the implementation of various Internet based applications from the respective software vendors. Quality of information and the quality of work content will improve significantly removing a lot of the drudgery from current work practices and reducing the effort associated with obtaining and reviewing business information at present. Staff morale and healthy competition will be boosted by the ready availability of business performance information. Corporate image will be enhanced by the high-tech approach to business management and control.

2.2 Payback

The second heading under which the system was evaluated is titled "Payback". The specific criteria in this area are identified as the ability of the system to achieve the following:

2.2.1 Direct cost savings

	SAP	Scala	Oracle
• Reduced product cycle time	(9)	(8)	(8)
• Displace current costs or avoid future costs	(7)	(6)	(6)
• Reduced inventories	(8)	(7)	(6)
• Reduced stock write-offs (obsolescence, scrap, etc.)	(7)	(7)	(7)
• Assist in component cost reduction programme	(7)	(7)	(7)
• Implement tighter Project control	(8)	(6)	(6)
• Reduced communications costs (e-mail)	(5)	(5)	(5)
• Improved cash-flow	(9)	(7)	(6)
• Less need for specialised (more expensive) staff	(6)	(6)	(6)
Sub-total	(66)	(59)	(57)

It is difficult to quantify specific direct cost savings for the BMS. It is often the case that following the implementation of a BMS costs will actually rise for a short period. However, it should be possible to determine savings in inventory, reduced write-offs and reduced stationery costs at ORGANISATION 5. The BMS should provide component analysis in order to contribute to the ongoing challenge of reducing component costs at both the design and implementation phase. Cash flow should improve significantly due to tighter management and on-line integration between the various business functions which impact cash flow (Sales, Manufacturing, Purchasing and Finance). The implementation of a sophisticated financial application should reduce the requirement for specialised staff at ORGANISATION 5. It should also ensure that ORGANISATION 5 can cope with increased levels of business with the same staff levels.

2.2.2 Quality

	SAP	Scala	Oracle
• Better information on recalls/returns	(8)	(7)	(7)
• Fewer recalls/returns	(8)	(8)	(8)
• Improved customer service	(9)	(8)	(8)
• Better visibility for customer on order fulfilment process	(10)	(8)	(8)
• Fewer customer complaints	(8)	(8)	(8)
• Fewer mistakes in invoicing/delivery etc.	(9)	(9)	(9)
• Improved invoicing information	(9)	(9)	(9)
• Reduced order/delivery time span	(9)	(9)	(9)
• Less reworking, re-keying of information	(9)	(9)	(9)
• Reduce errors, re-submissions and re-run	(8)	(8)	(8)
Sub-total	(87)	(83)	(83)

All of the proposed business systems will provide high quality business performance information on-line. This will in turn lead to changes in work practices as much time will now be saved in collating, organising and presenting data. The underlying database will provide integrity constraints which will minimise errors and ensure the validity of the data concerned. SAP will provide Internet ' applets' which allow specific ORGANISATION 5 customer query order activity and progress. This benefit will be minimised to some degree if the manufacturing process at the sub-contractor remains off-line to the ORGANISATION 5 system. However, other sales, engineering (BOM, ECO's) and purchasing data can be made available via these applets. This will provide ORGANISATION 5 with competitive advantage and reduce the amount of time spent answering customer / supplier / sub-contractor queries. It is expected that this will ultimately result in improved customer perception of ORGANISATION 5 and a reduction in customer complaints.

2.2.3 Productivity

	SAP	Scala	Oracle
• Facilitate product differentiation or new product introduction	(9)	(6)	(6)
• Create additional revenue	(8)	(8)	(8)
• Higher sales per employee	(9)	(8)	(8)
• More throughput per employee	(8)	(8)	(8)
• Handle increased volume with similar staff numbers	(9)	(9)	(9)
• Fewer phone calls, memoranda, etc.	(5)	(5)	(5)
• Fewer queries (employees handle their own problems better)	(6)	(6)	(6)
• Better alignment with peaks and troughs	(7)	(7)	(7)
• Revenue earnings	(9)	(8)	(8)
• Reduction in or elimination of production or delivery bottlenecks	(6)	(6)	(6)
• Reduction in or elimination of non-value adding task	(9)	(7)	(7)
• Reduction in order turnaround time	(8)	(7)	(7)
• Reduction in audit costs due to better information	(5)	(5)	(5)
• Faster access to information (not necessarily a benefit)	(9)	(9)	(9)
• Better on-line help to reduce support costs	(4)	(4)	(4)
• Less re-keying of data	(9)	(9)	(9)
• Less manual aggregating of data	(9)	(9)	(9)
Sub-total	(129)	(121)	(121)

Productivity will increase as a result of implementing a BMS. The amount of time spent at present in ORGANISATION 5 in obtaining data, then analysing and formatting this data is considerable right across the organisation. This applies to all departments, sales, manufacturing and distribution. The new application will present a central point for data analysis and allow ORGANISATION 5 personnel to concentrate on using the information to the benefit of the organisation. There is too much time spent right now in obtaining the data rather than interpreting the information. Therefore, all of the products score well in this regard.

2.2.4 Employee performance

	SAP	Scala	Oracle
• Better quality of information (less wasted time)	(10)	(9)	(9)
• Reduced frustration	(8)	(8)	(8)
• Empowerment/reduced need for supervision	(8)	(8)	(8)
• Reduce time spent on non-value adding tasks	(9)	(9)	(9)
• Fewer occasions for mistakes	(8)	(8)	(8)
• Easier to recover from mistakes	(8)	(8)	(8)
• Reduced need for training (system is intuitive)	(6)	(7)	(6)
• Easier to recruit staff (system environment in wide usage)	(4)	(8)	(4)
• More flexible working conditions	(7)	(7)	(7)
• Improved self-image (staff applying high-tech)	(9)	(7)	(8)
• Safer environment	(3)	(3)	(3)
Sub-total	(80)	(82)	(78)

Employee performance will be boosted by the introduction of the new application. There will be less time obtaining, analysing and presenting information. Key business information will now be available on-line thereby reducing the level of time spent obtaining this information in the present environment. This should reduce frustration and improve the working environment for ORGANISATION 5 personnel. The centralising of the data in a structured manner will reduce the risk of errors, re-runs and wrong interpretation of data to a great extent. This is an area which will have a big impact in the new application and consequently all products scored well here.

2.2.5 Management performance

	SAP	Scala	Oracle
• Better information	(10)	(8)	(8)
• Faster information	(9)	(8)	(8)
• Improved decision support capability	(9)	(9)	(9)
• Reduction in number of meetings due to better information	(3)	(3)	(3)
• Improve management control	(10)	(10)	(10)

- Provide management time savings (9) (9) (9)

Sub-total	(50)	(47)	(47)
Sub-total 2	(412)	(392)	(386)
Average	(8)	(7)	(7)

Management performance should improve with the availability of key business performance information at the touch of a button. This will facilitate better decision making and improved business control. It should also significantly reduce the time spent by management in data preparation and analysis as this can be done on-line within the new application. Again, this is an area of major impact and all products scored well here.

2.2.6 Payback - Direct Benefits Summary

All of the proposed systems score well under the heading of direct benefits. Generally, a BMS will help ORGANISATION 5 management strive for improved business control with the following business benefits:

Improved cash management / reduced costs.

Key management information will be available on-line and can be monitored on an on-going basis. Workflow enabled applications will allow ORGANISATION 5 management to manage by exception thereby focusing on the real business issues on a daily basis.

Centralised business system

The implementation should significantly streamline the information exchange process within ORGANISATION 5 whilst capitalising on existing investment in PC and NT server technology.

Productivity and efficiency

The BMS will eliminate tasks associated with data collection and presentation and this will provide improvements in revenue generation.

Customer service

This will be better supported through the ready availability of order fulfilment, financial and statistical information as well as providing key ORGANISATION 5 customers with Internet facilities to interrogate the Order Fulfilment process at ORGANISATION 5.

Manufacturing

This will benefit from the implementation of the system through on-line demand information, improved stores and stock management and direct connections to warehousing functions for business information exchange.

Engineering Change Management

This will be streamlined in both time and accuracy as will the generation, maintenance and modification of Engineering Change Orders, Engineering Change Requests and Bills Of Materials. The automation of these tasks will speed up the introduction of new products into the ORGANISATION 5 group.

2.3 Architecture

The third category of evaluation is "Architecture" i.e. the information systems and networks used to support the information management requirements in ORGANISATION 5. The following criteria are used to evaluate the system under this heading:

	SAP	Scala	Oracle
• Conform to IT architecture as defined	(10)	(8)	(7)
• Pre-emptive use of technology (BPR, workflow, EDI, Internet)	(10)	(5)	(7)
• Cater for increased data volumes	(9)	(8)	(8)
• Enhance flexibility by de-coupling applications from infrastructure (operate in stand-alone or integrated mode).	(5)	(8)	(8)
• Conform to Database standards (SQL level 2 compliant)	(10)	(10)	(10)
• GUI enabled f8FEF-end (Windows 3.11, 95, NT client)	(10)	(10)	(10)
• Support open access to data through ODBC	(9)	(9)	(9)
• Available on leading network operating environments (Ethernet, TCP/IP)	(10)	(10)	(10)
• Support for Object Linking & Embedding (OLE)	(10)	(5)	(8)
• Internet enabled	(10)	(4)	(7)
• Open to on-line integration with third party products	(10)	(10)	(10)
• Scaleable in terms of users supported	(8)	(8)	(8)

• Integration of personal and corporate computing environments	(10)	(6)	(9)
• Impact on other applications	(8)	(8)	(8)
• Support for future applications	(9)	(9)	(9)
Sub-total	(138)	(118)	(128)
Average	(9)	(8)	(9)

The implementation of the BMS will have a very positive impact on other applications by making accurate information available to areas such as Shipping, Purchasing, Production Planning, Sales, Finance, Banking and Distribution. The product which scores best in this area is SAP which has placed much of its product success on the back of MS NT. SAP R/3 is optimised for NT and has sold well on this platform to date. It is a true client server application supporting the three tiered concept of client, business and database server. It is also work flow enabled thereby enabling business processes to be created, amended and deleted as required. Scala and Oracle are essentially playing catch-up in the area of technical architecture - Oracle have yet to release the manufacturing modules on NT.

Support of future applications is secure by virtue of the fact that SAP, Scala and Oracle conform to open systems concepts and standards.

2.4 Process Re-design

The fourth category of system evaluation is "Process Redesign" i.e. the ability of the system to cope with and assist in changing work practices and processes in the future. The following criteria were used to evaluate the system under this heading:

	SAP	Scala	Oracle
• Provision of greater flexibility in work practices	(10)	(6)	(9)
• Facilitation of process approach to business	(10)	(4)	(8)
• Supports ongoing changes in the business processes	(9)	(4)	(9)
• Capacity to support new processes	(10)	(4)	(10)
• Capture data more than once	(9)	(9)	(9)
• Can existing data be leveraged	(9)	(9)	(9)
Sub-total	(57)	(36)	(54)

Average	(10)	(6)	(9)

SAP scores extremely well with respect to redesign. SAP is built around business processes (the application comes with 800 business processes as standard all of which conform to global best business practices). SAP also ships with a workflow engine as standard as well as document management functionality. Oracle supports process redesign via its Oracle workflow engine as well through its Business Objects applications. It is workflow enabled in the manufacturing and distribution modules but not in the financial modules. Scala does not support a process based architecture (built around business processes such as order fulfilment, distribution etc.). SAP ships with functionality which support process analysis, design, redesign and optimisation. However, all of this is purchased at a cost in terms of consultancy. On balance, SAP will add to ORGANISATION 5's capacity to re-engineer in the future if required. The ready availability of existing business process documentation will facilitate implementation and the SAP Business Process Analysis tool-kits will certainly support the process approach to business and highlight areas where work practices are not in order. Oracle will provide similar functionality though not as comprehensive as SAP. Scala is weak in this area but, are in principle committed to moving in this direction.

2.5 Risk

The final evaluation category is "Risk". The criteria encompassed by "Risk" cover the most common reasons for IT project failure and are listed here.

	SAP	Scala	Oracle
• Project scale	(4)	(7)	(5)
• Time frame - the longer the greater the risk	(5)	(8)	(6)
• Top management support	(10)	(10)	(10)
• Vendor reliability	(9)	(9)	(9)
• Platform stability	(9)	(9)	(9)
• Technical risk	(8)	(6)	(7)
• Employee and management ability, attitude and availability	(6)	(7)	(6)
Sub-total	(51)	(56)	(52)

Average	(7)	(8)	(7)

The various systems score relatively poorly under the heading of "Risk". This is due to the high risk normally associated with the implementation of a BMS particularly in the areas of scale, costs, time-frame, implementation and resources. There are no problems in the area of top management backing. Employee support may be an issue due to the change of work practices which will arise due to the BMS implementation. Also, there will be a reduction in the power associated with information gate-keeping for some employees. This may hinder a successful implementation and will need to be addressed. The implementation for both SAP and Oracle are usually of the 12-24 months time-frame for a company such as ORGANISATION 5. This is due to the consultancy requirement in order to take full advantage of all product features. The risk with project scale for Scala is much less as this product does not require the same level of consultancy as SAP or Oracle. However, it may be that in implementing Scala, ORGANISATION 5 would simply automate processes which have in-built inefficiencies.

The following sections of this report show the evaluation results in detail.

3. STRATEGIC ALIGNMENT - DETAILED ANALYSIS

Benefits	*SAP*	*Scala*	*Oracle*
Support for mergers / acquisitions / alliances All of the applications can cope adequately in this regard through an open systems approach.	8	8	8
Capacity to enable ORGANISATION 5 to do business in new ways SAP R/3 ships with sophisticated business modelling and redesign functionality and is clearly superior to the other applications is this area. SAP ships with 800 processes defined but users may model and define their own processes should they so require. Scala and Oracle score poorly in this regard as they are built around functional areas such as Accounts Receivable, Inventory Management and Distribution.	9	5	8
Impact on corporate image? Positive impact - the availability of on-line business critical information clearly demonstrates management commitment to continuous improvement. The implementation of a product such as SAP or Oracle will also send out positive signals to the market place that ORGANISATION 5 are committed to providing the best IT infrastructure for the organisation. A product such as Scala will also be received in a positive light but not to the extent that SAP / Oracle would be as these are the world leaders in BMS.	9	6	8
Are strategic goals clear and consistent? If not alignment will be difficult irrespective of the value of the system. The purpose of the Business Management System is to assist in the reduction of time to market for new product, to ensure customer service levels are improved and to increase efficiency and productivity through improved business management and control.	10	10	10
Empowerment - reduced need for supervision This type of system will provide real empowerment to business users in their day to day tasks. All products score well in this regard. It is worth noting that this benefit is contingent on adequate training and education with respect to the BMS being carried out.	8	8	8
Support moves to new geographical markets ? Both SAP and Scala are truly international business systems and conform to financial and legal accounting rules for over 15 countries. Oracle has only recently moved in this direction and is in 'catch up' mode in this regard. Foreign language versions of the products are also available.	9	9	8

Benefits	SAP	Scala	Oracle
Enhanced linkages with customers / suppliers and sub-contractors All of the products score well in this respect with all products conforming to open systems standards as well as supporting Electronic Data Interchange (EDI).	10	9	

4. PAYBACK - DETAILED ANALYSIS

4.1 Direct cost savings

Benefits	*SAP*	*Scala*	*Oracle*
Reduced new product cycle time All of the products can contribute to a reduction in new product cycle time. Key functionality for design engineers such as Engineering Change Management (automated ECRs, ECOs and BOM generation and maintenance) will ensure that key manual tasks are automated and controlled. This will reduce the amount of time spent keeping these documents up to date in a manual environment. Project Management will be empowered via the usage of Project Costing functionality which will provide on-line visibility from a project control perspective. SAP scores particularly well in this regard due mainly to its BPR capability to modify the core business processes within the application. This could make a critical contribution to any BPI projects in the future which were geared to further streamline ORGANISATION 5s business processes.	9	8	8
Does it displace costs or avoid future costs? The products scored should reduce ongoing costs in administration, data analysis and information processing. Staff levels in accounting and administration should be stabilised and the existing resources should be more than capable of handling increased volumes of data. The availability of on-line business critical data in user defined formats should reduce the need for staff to spend vast amounts of time on data collection, analysis and presentation. SAP does provide more business functionality (Human Resources and payroll, no Irish payroll yet) than the other applications and that is why it out-scored the others here.	7	6	6
Reduced Inventories ? This should be facilitated by a tighter management control on inventory within the organisation. The introduction of an on-line business application will provide current and trend information on stock levels, sales analysis and forecasting. It will also provide connectivity to external warehousing and allow management focus on stock levels and set in motion initiatives to drive down stock levels within the organisation. This should apply to all the companies within the group but in particular ORGANISATION 5 Communications Ltd. and ORGANISATION 5 Communications Ireland Ltd. ORGANISATION 5 Communications Systems Ltd. need to automate their inventory control procedures immediately. Oracle	8	7	6

Benefits	SAP	Scala	Oracle
Inventory does not support FIFO and scores lowest as a result.			
Cash flow / liquidity? The implementation of an on-line integrated BMS should contribute significantly to an improved cash flow position. All of the products score well in this area providing specific functionality to fulfil this requirement and collate the information required from a number of key modules (Purchasing, Sales, Manufacturing and Finance).	9	9	9
Staff morale The implementation of a BMS which will significantly reduce the work load will be received in a very positive light by all staff. It will greatly reduce the time spent on mundane tasks associated with data collection, analysis and presentation and should ensure that present tasks are made much easier by the new system.	9	9	9
Impact on customer service? Should improve customer service through better visibility on order fulfilment process. The ability to provide a customer such as BT with Internet applications in order to query invoices, orders, shipments will reduce customer queries via phone and free key staff up to undertake more value added tasks.	9	8	9
Impact on quality? A positive impact. Will help automate some key business functions such as Engineering Change Management, Bill Of Materials maintenance. The implementation of a Document Management System with the relevant linkages to CAD will mean tighter integration and automation across business units. Workflow will promote the work-group ethic within the organisation. It will also provide key business information in a reliable and professional format. The ability of a product such as SAP to implement best business practice processes for electronic design should also raise the Quality standards within ORGANISATION 5.	9	8	8

Benefits	*SAP*	*Scala*	*Oracle*
Reduced stock write-offs (obsolescence, scrap, etc.) All of the applications provide comprehensive functionality to plan a scrap factor per each material within a BOM and then to analyse planned versus actual. This will provide ORGANISATION 5 with the necessary information to manage this area effectively.	7	7	7
Assist in component cost reduction programme This will be enabled by the capability to build custom queries, reports and alerts on the business system to view alternate components based on user defined criteria e.g. cost, quality or technical features. The fact that all products conform to open systems standards makes this task much easier.	7	7	7
Implement tighter Project control All 3 products ship with comprehensive project control and costing modules. These provide the necessary features to create, control and manage internal projects. These modules are all integrated within the system to other modules (purchasing, sales, GL).	6	6	6
Reduce communications costs e.g. e-mail It is not envisaged that any of the products reviewed will have a major impact in reducing communications costs.	5	5	5
Improved cash flow This is an area that will be critical for effective business management. Cash flow should be improved by the fact that all modules affecting cash flow are integrated providing detailed analysis of sales forecasts, stock levels, purchasing and banking all of which ultimately impact on cash. SAP ships with a comprehensive cash, funds and treasury management module. Oracle have just released their cash management module whilst Scala provides a standard cash management module which is an optional extra.	9	7	6
Less need for specialised (more expensive) staff The purchase of a complex business system will reduce the need for specialised staff in the accounting / administration areas. It is important to note that the current staff have an important contribution to make especially in the implementation of the new system. Their knowledge of the ORGANISATION 5 business and its accounting requirements will be invaluable during the implementation project.	6	6	6

4.2 Quality

Benefits	*SAP*	*Scala*	*Oracle*
Better information on returns / recalls This will be facilitated by better integration between ORGANISATION 5 and sub-contractors. This information is maintained at the moment by the sub-contractors and then transmitted to ORGANISATION 5. There is a time delay from 3 weeks to 3 months to obtain this data. The sub-contractor should update the BMS on-line with this information either via dial-up connection or an Internet application. SAP again out-scores here due to its Internet capability.	8	7	7
Fewer recalls / returns It should follow that as a result of detailed analysis of the reason for recalls / returns that ORGANISATION 5 should be in a position to rectify the reasons for same. This will be enabled within the application by strong decision support features. Again, this is a feature common to all the applications due to their conformance to open systems standards.	8	8	8
Improved Customer Service This is a critical benefit of any new business system for ORGANISATION 5. Customer service will be improved across many fronts - improved customer information, better order fulfilment visibility, better recalls / returns analysis, improved customer statistics and trending. The capability offered by Internet based applications to provide such information to ORGANISATION 5 customers on their own desktop will provide ORGANISATION 5 with significant competitive advantage. It will also result in ORGANISATION 5 being perceived as a sophisticated IT organisation thereby boosting the corporate image. A further benefit from this will be the amount of time saved by ORGANISATION 5 staff in providing this information and answering phone queries re same. SAP again comes out on top here due to its Internet and application based functionality as well as its in built security features.	9	8	8
Better visibility for customer on order fulfilment process. The business systems scored are all customer centric applications in that they all provide comprehensive func-	10	8	8

Benefits	*SAP*	*Scala*	*Oracle*
tionality in the order fulfilment process. This will allow users to view all orders on screen for a particular customer which will further break those orders down into the relevant order lines. Order status will be available i.e. at the warehouse, in production, to be completed which will provide order fulfilment information to the user. Finance specific information and statistics will also be available displaying customers purchasing history, payment trends, average payment days, top 10 products and available credit terms. SAP moves this a step further by providing specific Internet applications to allow the customer to process these enquiries from his / her own desk-top. SAP is also moving to allow all business type transactions to be processed via the Internet.			
Fewer customer complaints The improvements to customer service and better visibility on the order fulfilment process should logically result in fewer customer complaints.	8	8	8
Improved Invoicing information This will be a result of implementing an integrated business system and will be achieved by tighter information exchange between the distribution and accounts receivable processes. Warehouses will be required to update ORGANISATION 5 with products shipments and sales invoice information. Standard invoicing functionality will be available for on-line invoice processing.	9	9	9
Reduced order / delivery time span This will be achieved by tighter integration between the various business functions at ORGANISATION 5 which manage the order fulfilment process. The implementation of an integrated business system with a single view on the business will play a vital role in achieving this business goal. This functionality is standard with all applications.	9	9	9
Less re-working, re-keying of information This is a major problem at ORGANISATION 5 and an inhibitor to business growth. There are a number of man days lost per day in this task. An integrated application will require that data is only entered once into the appli-	9	9	9

Benefits	*SAP*	*Scala*	*Oracle*
cation and is available for analysis immediately across the organisation. This will have a major impact at ORGANI SATION 5. This integration is now a standard feature with all business systems.			
Reduced errors, re-submissions and re-runs The fact that users will only need to enter data once and that because of the integration features that this data is available across all business functions will reduce the potential significantly for errors. Also, the fact that standard business enquiries and reports will be available will reduce the potential for data mis-interpretation due to errors in spreadsheet formulae.	8	8	8

4.3 **Productivity**

Benefits	*SAP*	*Scala*	*Oracle*
Facilitate product differentiation or new product introduction This will be achieved primarily by use of Engineering Change Management, CAD integration, Document management, Workflow, Redesign and Manufacturing functionality. This will be the IT tool-sets used by key ORGANISATION 5 resources to automate and control critical business processes. SAP is the winner here shipping the above functionality as standard within its application.	9	6	6
Create additional revenue A number of key Account Managers at ORGANISATION 5 spend too much time in data collection, analysis and presentation. These people should spend their time maximising commercial opportunities with ORGANISATION 5 clients. The new BMS will provide the data in an integrated on-line user defined format. It should be a consequence of this that there would be an increase in revenue to the organisation. This should be quantitative benefit. The key application features required here are supported across all three products.	8	8	8
Higher sales per employee This is a follow on from the 'create additional revenue' benefit. Higher sales per employee will happen if the additional revenue benefit happens. This should be a quantitative benefit. SAP out-scores the others by reason that it provides specific sales analysis, billing and sales support functionality.	9	8	8
More throughput per employee The fact that data will only be required to be entered once within the application will reduce the time spent in rekeying data across all business functions. It would be logical therefore to expect higher throughput per employee as a result of implementing the new system. However, this would need to be closely monitored in order to determine the success or failure of same. All of the products will facilitate this.	8	8	8

Benefits	*SAP*	*Scala*	*Oracle*
Handle increased volumes with similar staff numbers The BMS will automate many of the routine and mundane tasks currently using up much of the staff time. Therefore, current staff levels will be able to handle increases in business volumes but this is dependant on the automation and integration of key business functions.	9	9	9
Fewer phone calls, memoranda etc. An integrated application may in fact promote a closer workgroup type culture and also encourage staff to discuss key business issues based on better business information.	5	5	5
Fewer queries (employees handle their own problems better) The fact all business data is centralised and is available to all employees (security dependant) means that people are empowered to resolve business issues as they arise i.e. customer account enquiry, stock availability. The products score equally in this regard.	6	6	6
Better alignment with peaks and troughs The implementation of an integrated system will provide critical business information to management (sales surges, fall off in demand, gross margins movements) which will allow ORGANISATION 5 time to plan and manage these situations accordingly. Again, this functionality is common the all the scored applications.	7	7	7
Revenue earnings This benefit is dealt with in detail under the heading 'Create additional revenue'. In summary, sales analysis and product profitability information from the business system may highlight opportunities for new business across the different market sectors. This could be a critical benefit from the new system. SAP out-score its competitors here due to the rich functionality within its Sales Analysis module.	9	8	8
Reduction in or elimination of production or delivery bottlenecks This is a difficult benefit to assess as ORGANISATION 5 outsource the majority of its manufacturing to sub-contractors. Also, the delivery / distribution is managed by	6	6	6

Benefits	*SAP*	*Scala*	*Oracle*
warehousing / sub-contractor or freight agents dependant on market and / or customer. There will be benefits from a centralised system if there is data exchange to / from sub-contractors and warehousing. This requires further analysis and study before commitments can be made in this area.			
Reduction in or elimination of non value adding tasks The implementation of an integrated business system will reduce dramatically the amount of time spent by employees in data collection, analysis, preparation and interpretation. This happens right across the business from sales to manufacturing and has given rise to information gatekeeping due to the political power associated with employees who have access to critical business data. This should not arise the new application will deliver significant benefits in this regard. The capability of SAP with respect to workflow and the ability to manage by exception with workflow mean SAP outscores the other products here.	9	7	7
Reduction in order turnaround time This will be enabled by better visibility on the order fulfilment process and the identification of bottlenecks within same. SAP outscores due to its redesign and process modelling functionality.	8	7	7
Reduction in audit costs due to better information The implementation of a business system will provide detailed financial and management accounting information in a more stable manner than before. However, it is not possible to determine that this will result in the ORGANISATION 5 auditors reducing their audit fees. It may be worth while senior management at ORGANISATION 5 exploring this opportunity with their auditors.	5	5	5
Faster access to information The fact that this will be an integrated application will mean that all ORGANISATION 5 employees, depending on security privileges, will have direct access to on-line information once data is input to the application. This will be a dramatic increase from the current situation where data has to be transferred from Impcon, spreadsheet, WP before any analysis is done on same.	9	9	9

Benefits

	SAP	Scala	Oracle
Better on-line Help to reduce support costs It is not felt that on-line help will have a significant bearing on support costs which are set at 15% of retail price in any case. This system is critical to the future of ORGANISATION 5 and so support for same will be quite different to an off the shelf products (Word, Excel) support structure. It will be crucial to ORGANISATION 5 to have support facilities available 12 hours a day for this system.	4	4	4
Less re-keying of data All the selected systems modules are fully integrated. This will virtually eliminate the need to re-key data. This will also mean that users can integrate with spreadsheet technology on-line.	9	9	9
Less manual aggregating of data The systems scored within this study all ship with comprehensive query and reporting tools. SAP ships with an in-built EIS whilst Scala and Oracle provide same as an optional extra. These tool-sets will facilitate the orderly analysis of the on-line business data and reduce the need for staff to spend days and days analysing and interpreting data that is already out of date.	9	9	9

4.4 Employee performance

Benefit	*SAP*	*Scala*	*Oracle*
Better quality of information (less wasted time) The implementation of an integrated, on-line business system will provide better, faster and more accurate business information. SAP ships workflow, CAD integration, document management, engineering change management, sales analysis and EIS modules within the standard application. These will provide ORGANISATION 5 with critical business information and therefore outscores the competitors.	10	9	9
Reduced frustration There is a lot of frustration at the moment with respect to the current information systems. This is mainly to do with the inflexible nature of the current information systems and the amount of time required to obtain business information from same. In fact, in a number of critical areas the information processing is done via spreadsheet which results in a number of different views on the business. Frustration will be reduced by the implementation of an integrated business system which can provide on-line business performance information quickly and effectively.	8	8	8
Empowerment / reduced need for supervision The availability of key performance information online will reduce the need for employees to spend time in obtaining information via telephone or direct discussion. Business information specific to their job will be available allowing them to make basic business decisions quickly and without the need to refer to other functions within the business.	8	8	8
Reduced time spent on non value adding tasks This will be resolved by the integrated business system. Once data is entered on the system it will be available to all employees (security privileges dependant). This new system will ship with sophisticated enquiries and report functionality as standard. These can be modified on a per user basis if required. This will reduce significantly the time spent on data management by all employees across the business and allow them to focus on their specific job	9	9	9

Benefits	***SAP***	***Scala***	***Oracle***
functions (Account Management, Finance, Manufacturing etc.) rather than on data manipulation.			
Fewer occasions for mistakes The fact that all information is stored centrally and that this information is validated by appropriate business rules stored at the database will reduce the potentials for mistakes and invalid data. Also, the reduction in re-keying data will contribute here.	8	8	8
Easier to recover from mistakes Once data is entered for a specific transaction (GRN) it is then available to all users within the application. However, should there be an error with regards to this transaction then the system will provide specific functionality (stock adjustment, write-off)in order to rectify the error. This information will then be made available to all users and a full audit trail is generated of all transactions for control purposes. This type of functionality enables users to rectify errors in a controlled and orderly manner.	8	8	8
Reduced need for training (system is intuitive) The implementation of a complex business system usually takes up to 1 year to complete (go live). These systems come with much functionality parameterised and users will require education and training in order to fully grasp the business logic behind the system. This will be especially true for SAP and Oracle. GUI and on-line help functionality will certainly contribute to the user friendliness of the application.	6	7	6
Easier to recruit staff (system in wide usage) Skilled staff for complex business systems are always in short supply and this is especially true for products such as Oracle and SAP. However, the impact on working conditions, staff morale and image will certainly render ORGANISATION 5 more attractive in recruitment terms. Scala easily outscores the other products due to its wide usage, ease of implementation and low requirement for specific Scala skill-sets.	4	8	4
More flexible working conditions The new business system will certainly improve working conditions for staff with the availability of on-line busi-	7	7	7

Benefits	*SAP*	*Scala*	*Oracle*
ness information, integration features, automation of routine tasks and reduced data manipulation. All products score equally here.			
Improved self image (staff employing high tech) The implementation will mean that all staff using the new system will be educated and trained in its features, processes, capabilities and risks. This will have a positive effect on employees self image and will boost their worth to the organisation. However, it will create a risk that these employees may be recruited by other organisations for similar implementations. SAP is the No. 1 product to implement in terms of image and prestige with Oracle a close second.	9	7	8
Safer environment This is not a strategic issue for ORGANISATION 5.	3	3	3

4.5 Management performance

Benefit	*SAP*	*Scala*	*Oracle*
Better information The implementation of an integrated business system will mean that in information terms, there is one view on the business. The capability of the new system to deliver user defined reports / graphs on business performance and metrics will result in management being provided with better business information. SAP scores top marks due to its rich functionality for senior management particularly in the areas of EIS, DSS and graphics.	10	8	8
Faster information The fact that all information is on-line and available once it is input will ensure information is available much faster than before. This wi'l profound impact on work practices at ORGANISATION 5. SAP is an on-line application e.g. once a GRN is entered the GL is updated. This tight integration is akey benefit of the product.. However, it is important to note that all of the products scored will deliver key benefits in this area.	9	8	8
Improved decision support capability The ability of the system to interrogate, analyse and present business information in a structured and professional manner is crucial. The system must be flexible and adaptable to allow parameters and business rules to change depending on the business situation. All of the products score well in this regard.	9	9	9
Reduction in number of meetings due to better information It is felt that the implementation will have a minimal impact with respect to this benefit.	3	3	3
Improved management control Key business performance statistics will be available on-line from the new business system. This will allow management to act in a quick but effective manner to issues as they arise i.e. manage by exception. Currently, there can be time delays of more than one week in presenting business performance information, in fact it can take up to one week to prepare this information for management which will be available on-line in the new system.	10	10	10
Provide management time savings The ability to obtain and act on critical business information in a fast and effective manner will save management time. It will also empower senior management to obtain key business performance reports directly from the system via the EIS without having to request same from Finance.	9	9	9

5. ARCHITECTURE - DETAILED ANALYSIS

Benefit	*SAP*	*Scala*	*Oracle*
Conform to ORGANISATION 5 IT architecture as defined All products conform in principle to the ORGANISATION 5 IT architecture (see ORGANISATION 5 IT Strategy report). However, SAP R/3 has been targeted specifically for the NT and NT SQL server environment (30% of SAP shipments in final 6 months of 1995 were NT based) and SAP and Microsoft have worked in partnership on R/3 with respect to Internet functionality. Oracle are at present porting some of their product to NT. Scala will work well on NT but is still in the early phases of running on SQL server 6.0.	10	8	7
Pre-emptive use of technology (process modelling and supports process based architecture, workflow, EDI and Internet capability) SAP R/3 easily wins this section as it ships all of the above features as standard. Oracle has workflow technology and some of its products are workflow enabled. However, it is still playing catch-up in this area. Scala does not support any of these features.	10	5	7
Cater for increased data volumes SAP has a three tiered client server architecture (client, business rules and database). It has a 'thin client' approach with all transaction processing carried out at the server end. Oracle has just moved in this direction with its new release called 'smart client'. Scala is two tiered at present (client / server) and builds different products for different database environments. SAP is best positioned in terms of architecture and performance criteria to support increased data volumes but it should be stressed here that all of the products perform well in this regard.	9	8	8
Enhance flexibility by de-coupling applications from infrastructure (operate in stand-alone or integrated mode) SAP ships as one tightly integrated application that runs on multiple platforms. Its tight integration between modules renders it difficult to interface with third party business products. Scala and Oracle sell individual modules (GL, AR, AP) which generally will run stand-alone or integrated and are available on multiple platforms.	5	8	8
Conform to database standards (SQL level 2 compliant) Oracle is a SQL level 2 compliant database. All applications scored will run under the Oracle database environment.	10	10	10
GUI enabled front-end (Windows 3.11, Windows95, NT client) All products conform to this standard. Oracle and Scala are com-	10	10	10

Benefits	*SAP*	*Scala*	*Oracle*
pleting the port to Windows95 and NT client and so availability may be an issue. All of these organisations are 100% committed to NT.			
Support open access to data through ODBC All of the products use proprietary access techniques to the database from within the applications. However, all the databases support ODBC.	9	9	9
Available on leading network operating environments (Ethernet / TCP/IP) All products conform to this standard.	10	10	10
Support for Object Linking & Embedding (OLE) SAP supports OLE extensively and ships Microsoft Office (Word, Excel and Powerpoint) as part of its core product. There applications are embedded in SAP. Oracle supports OLE in some of its modules (GL) but not all. Scala do not support OLE 100% at present but are committed to OLE conformance.	10	5	8
Internet enabled SAP ships with a number of business applications that are Internet based and its present Internet capability and vision is far superior to its competitors. Internet applications from SAP at the moment allow customers view order status, shipment information and other order fulfilment information. Oracle also provides such functionality but at an extra cost. Scala does not provide such features yet but are committed to Internet enabling their application. SAP are committed to making R/3 available on the Internet in terms of transaction processing (Order entry etc.) and are working in partnership with Microsoft in this regard.	10	4	7
Open to on-line integration with third party products All products conform to open systems standards which includes ODBC compliance, database standards and business objects. Therefore, integration should be a straight-forward process but will be dependant on the other applications in the integration process.	10	10	10
Scaleable in terms of users supported This is database dependant but as all the systems run under the market leader (Oracle) this should not be an issue.	8	8	8
Integration of personal and corporate computing environments This is dealt with in the 'OLE compliance' benefit. In summary, SAP ships with Microsoft Office and supports on-line integration to these tool-sets. Oracle does support this feature but only in	10	6	9

Benefits	***SAP***	***Scala***	***Oracle***
some modules. Scala is moving towards this environment (it does facilitate outputs to Excel) and have committed to upgrading users when the product is ready.			
Impact on other applications There will be minimal impact on other applications at ORGANI-SATION 5 as the new business system will replace the spread-sheet system, Impcon, PC software (bank reconciliation, Asgard) and other EDI applications. This will happen over time and new hardware resources will be required for the new system. All products score equally here.	8	8	8
Support for future applications All products conform to open systems standards and to the ORGANISATION 5 IT architecture as defined by the NIMT. This architecture has been defined with future-proofing in mind. The owners of the 3 business systems spend millions of dollars each year in R&D (Internet being a good example) and in new enhancements. All products score equally here.	9	9	9

6. PROCESS REDESIGN - DETAILED ANALYSIS

Benefits	*SAP*	*Scala*	*Oracle*
Provision of greater flexibility in work practices? SAP is process orientated and ships with thousands of pre-defined business processes which conform to best business practices. Users may implement these processes or define and implement their own specific business process via the Engineering workbench functionality. Workflow is also available enhancing the redesign capability of the product. All of the above will ensure that the IT applications underpinning the business processes are as flexible and adaptable as possible. Oracle is process orientated and supports workflow capability and ships as standard business processes applicable to the specific market sector of the client. Scala is not process based. SAP and Oracle can accommodate BPR change mid-project or alternatively, completely new processes may be defined and implemented.	10	6	9
Facilitation of a process approach to business SAP ships with 1000+ business processes per module all of which conforms to best business practice. SAP supports the dynamic creation and amendment of business processes. Oracle provides similar functionality. It is not clear if the financial modules within the Oracle suite conform to this model. The software tool-sets supplied by Oracle for this are expensive whilst SAP ships its tool-sets as standard. Scala does not provide such flexibility as Oracle or SAP but Scala is not targeted at the same market as the other products in terms of project scale and cost.	10	4	8
Supports ongoing change in the business processes SAP and Oracle support this feature through specific product features. Scala does not provide such functionality. However, changing or amending business processes post implementation can be a complicated task for SAP or Oracle. Also, users are locked into SAP and Oracle specific technology for this functionality.	9	4	9
Capacity to support new processes SAP and Oracle support this feature. SAP supplies this capability via its Engineering Workbench functionality. Oracle provides this functionality through its Workflow engine and Object2000 product sets. Scala does not support these features in such a flexible manner.	10	4	10
Capture data more than once The integrated nature of all the applications ensures that data is entered only once and then is available to all users of the applica-	9	9	9

Benefits	*SAP*	*Scala*	*Oracle*
tion. It is important to note that the data is available subject to users having the correct security privileges.			
Can existing data be leveraged All products facilitate data import and conversions.	9	9	9

7. RISK - DETAILED ANALYSIS

Benefits	*SAP*	*Scala*	*Oracle*
Project scale Implementing SAP or Oracle is quite a challenge. Success implementation requires business process redesign, a client-server environment, the ability to manage the systems flexibility, and the ability to cope with high complexity levels. Trained technical people are scarce and expensive. Therefore, the scale of the implementation is immense due to the above factors. Scala is a complex and feature rich application that does not require such consultancy effort yet will not produce the benefits that the other products could deliver. This is a critical issue for ORGANISATION 5 - if they choose a SAP or Oracle then they need to recognise the complexities associated with implementing such a product will present many challenges to the company during implementation but the benefits delivered to the business will be significant.	4	7	5
Time frame - the longer the greater the risk Time scales for SAP and Oracle implementation are usually spread over a number of years. This can be prohibitive in terms of time, costs and benefits delivered. However, both organisations now recognise this and have made considerable effort in the last 2 years to reduce this time. It should still take ORGANISATION 5 12-18 months to fully implement such a product. Scala is a straight-forward product aimed at operations such as ORGANISATION 5 and the time-frame for implementing this application would be 12 months.	5	8	6
Top management support Top management are fully supportive and committed to the implementation of a new business management system. Top management need to be involved on an ongoing basis on the project.	10	10	10
Vendor reliability All of the vendors listed (SAP, Oracle and Scala) are large multinational organisations delivering mission critical technology solutions to business. These companies are highly profitable and are expected to remain so for the foreseeable future.	9	9	9
Platform stability NT is now one of the best selling LAN operating systems. The product is feature rich and easily maintained. There is now a number of leading companies providing NT support and training in Dublin. SAP and Scala are available immediately under NT (30% of SAP sales 2nd half 1996 were on NT) but Oracle is	9	9	9

Benefits	*SAP*	*Scala*	*Oracle*
presently porting its application to NT. All vendors are committed to NT and therefore, platform stability is not a risk.			
Technical risk All of products conform to the open systems standard and include the latest in technology features. SAP outscores its competitors due to the depth of features available which are based on the latest in technology (workflow, Internet, CAD, document management etc.	8	6	7
Employee and management ability, attitude and availability It is essential that management are available and contribute to the implementation of the business system. This is particularly true of SAP and Oracle where much time in spent in understanding the business process, business process re-design, assessing the impact of business process re-design on the organisation and the implementation of same. It is essential that key management are actively involved in this process. The ability and commitment of ORGANISATION 5 personnel to capitalise on the better, more accurate business information will be critical for the success of the project. Scala does require commitment from senior management but not on such a scale as the other 2 applications and so out-scores them on this occasion.	6	7	6

SUMMARY OF ADJUSTED SCORES

Perspective	Weight	SAP	Scala	Oracle
Strategic Alignment	30	270	240	270
Payback	15	120	105	105
Architecture	25	225	200	225
Process Redesign	15	150	90	135
Risk	15	105	120	105
Total Adj. Score		870	755	840

8. APPROVED PDM VENDORS

8.1 SAP

Vendor : CAD & LAN Computersysteme
Product : AutoORG
Contact : Dr. Detlef Kahl
Address : Dr. Ernst-Mucke Str. 8, D-02625 Bautzen, Germany
Phone : +49 3591 3744 0
Fax : +49 3591 3744 19
Remarks: Certified interface: AutoORG STL 1.0;
Tested functionality: Material master, Document information, Bill of materials, Matchcode selection

Vendor : Computervision AG
Product : PORTA-X
Contact : Mr. Eduard Walther
Address : Hohlstrasse 534, CH-8048, Zurich, Switzerland.
Phone : +41 1 434 2145
Fax : +41 1 434 2100
Remarks: Certified interface: PORTA-X 1.0;
Tested functionality: Document information,

Vendor : VW-GEDAS
Product : priamos
Contact : Mr. Bernhard Herzog
Address : Pascalstr. 11, D10587 Berlin, Germany.
Phone : +49 3 9971 189
Fax : +49 3 9971 189
Remarks: Certified interface: priamos Online interface 1.0 for SAP system;
Tested functionality: Material master, Bill of materials, Matchcode selec tion.

9. PROJECT COSTINGS

The following costs are outline costs only for each product. The people at SAP, Controllers (Scala agents in Ireland) and CFM (Oracle business application partners) all refused to provide detailed quotations to ORGANISATION 5 without first spending some time understanding the business. This was not possible in the time-scale envisaged for the report. However, all of the vendors will be delighted to meet with ORGANISATION 5 to discuss their requirements in further detail at a later stage.

9.1 SAP

Contact: Jim Murray, SAP Ireland (01) 820 4446
Reference sites: AEG, Alcatel, AT&T, Fuji, Intel, Hitachi, Sony, Siemens.

Licence costs @ IR£3,000 per user (50 user licence)	IR£ 150,000
Database licences / client licences	IR£ 10,000
Implementation & Consultancy costs (ratio 1.5-1)	IR£ 225,000
Total	**IR£ 385,000**

9.2 Scala

Contact: Martin McFadden, Controllers Ltd. (01) 836 4188
Reference sites: Dell, Fujitsu, Nokia, Oki, Memorex Telex.

Software application	IR£100,000
Database licences / client licences	IR£ 10,000
Implementation & Consultancy costs (ratio 1-1)	IR£ 100,000
Total	**IR£ 210,000**

9.3 Oracle

Contact: Phil Codd, CFM Ltd. (01) 475 1670

Reference sites: Motorola.

Business System (16 modules * IR£8,500 approx.)	IR£ 136,000
Database licences	IR£ 25,000
Client Licences (50 * IR£1,300)	IR£ 65,000
Implementation & Consultancy costs (ratio 1- 1)	IR£ 136,000
Total	**IR£ 362,000**

10. PRODUCT FUNCTIONALITY LIST

10.1 SAP

Cross application

- Business Process Technology
- Document Management
- Classification
- CAD Integration
- Workflow

Financial Accounting

- General Ledger Accounting
- Consolidation
- Accounts Payable
- Accounts Receivable
- Asset Accounting
- Special Purpose Ledger

Treasury

- Cash Management
- Funds Management
- Treasury Management

Controlling

- Overhead Cost Control
- Product Cost Controlling
- Sales and Profitability Analysis
- Activity Based Costing
- Project Control

Capital Investment Management

- Tangible Fixed Assets
- Financial Investments

Enterprise Controlling

- Profit Centre Accounting
- Business Planning
- Management Consolidation
- Executive Information System

Logistics General

- Logistics Master Data

- Forecast
- Variant Configuration
- Engineering Change Management
- Logistics Information System

Materials Management

- Materials Requirements Planning
- Purchasing
- Inventory Management
- Warehouse Management
- Invoice Verification
- Information System
- Electronic Data Interchanges

Plant Maintenance

- Equipment and Technical Objects
- Preventative Maintenance
- Maintenance Order Management
- Maintenance Projects
- Service Management
- Plant Maintenance Information System

Project System

- Basic Data
- Operational Structures
- Project Planning
- Approval
- Project Execution / Integration
- Information System

Quality Management

- Planning Tools
- Inspection Processing
- Quality Control
- Quality Certificates
- Quality Notifications

Planning Production

- Basic Data
- Sales & Operations Planning
- Master Planning
- Capacity Requirements Planning

- Materials Requirements Planning
- Production Orders
- Product Costing
- Kanban / Just In Time (JIT)
- Repetitive Manufacturing
- Assembly Orders
- Production Planning for Process Industries
- Plant Data Collection
- Information System

Sales & Distribution

- Master Data
- Basic Functions
- Sales
- Shipping
- Billing
- Sales Support
- Information System
- Electronic Data Interchange

Personal Planning & Development

- Organisational Management
- Seminar and Conference Management
- Personnel Development
- Workforce Planning
- Room Reservations Planning

Personnel Administration

- Employee Management
- Benefits
- Compensation Administration
- Applicant Management
- Time Management
- Incentive Wages
- Travel Expenses
- Payroll

International Development

- Asian & Pacific Area
- Europe
- North America

- Africa / Middle East
- South America

10.2 Scala

Business application

- Windows clients
- Unlimited companies
- General Ledger (Report Writer, Cashbook, Bank Reconciliation)
- Company Consolidation
- Drill down / EIS
- Fixed Asset Management
- Accounts Receivable
- Credit Management
- Accounts Payable
- Sales Order Processing / Invoicing
- Stock Control
- Purchase Control
- Statistics (Sales, Purchases and Stock)
- Manufacturing, Planning and Control
- Costing
- Production Statistics
- Master Planning including Forecasting
- Materials Requirements Planning
- Scala Query

10.3 Oracle

Oracle Financials

- Assets
- Inventory
- Project Billing
- Purchasing
- General Ledger
- Payables
- Project Costing

- Receivables
- Applications Data Warehouse
- Financial Analyser

Oracle Manufacturing

- Capacity
- Cost Management
- Master Scheduling
- MRP
- Work In Progress
- Order Entry
- Bill Of Material
- Engineering
- Quality
- Manufacturing Planning

11. PDM FUNCTIONALITY CHECKLIST

Feature	*SAP*	*Scala*	*Oracle*
Document Management	Yes	No	No
CAD Integration	Yes	Yes	Yes*
Project Control	Yes	Yes	Yes
Workflow	Yes	No	Yes*
Quality Management	Yes	No	Yes*
Electronic Data Interchange	Yes	No	Yes*
Engineering Change Requests	Yes	Yes	Yes
Engineering Change Orders	Yes	Yes	Yes
Bill Of Material Management	Yes	Yes	Yes
Bill Of Materials Routing	Yes	No	Yes*
Component comparison analysis	Yes	Yes	Yes*
Flexible data structures for BOM technical data	Yes	Yes**	Yes**

Note: * = functionality not available in standard application so extra costs incurred.
** = Available re 'flex-fields'

Postal Survey: IT Investment and Payoff Issues

Summary of Findings

1. Investment in information technology controlled:

A.	Centrally	42.5%
B.	By Business divisions/units	10%
C.	A combination of both A. and B.	45%
D.	In other ways	2.5%

2. Budgetary Responsibility for the following categories of investment

	IT Function	Business Unit	Both	Other
Mainframe/data centres	77.5%	17.5%	7.5%	5%
Network Installation/maintenance	72.5%	15%	10%	2.5%
Personal Systems (other than PCs)	52.5%	15%	32.5%	0%
Personal Computers	40%	47.5%	12.5%	0%
IT Education and Training	30%	40%	22.5%	7.5%

3. Trend in budgetary responsibility in organisation to:

A.	Greater central control	25%
B.	More devolution to the business units	32.5%
C.	Increased joint responsibility	35%
D.	No change	7.5%

4. How well does organisation assess IT costs and IT benefits: Scale 5 (very successful) to 1 (unsuccessful)

	5 Very successful	4	3 Successful	2	1 Unsuccessful
IT Costs	12.5%	50%	35%	2.5%	0%
IT Benefits	2.5%	12.5%	47.5%	32.5%	5%

5. The biggest problems in accurately assessing

A. IT Costs

IT Costs (Problems)
No real problems
None - we do not engage external consultants!
Costs are easily identifiable
Identifying unanticipated costs
Size of Company
Ensuring that all possible costs are included, especially consequential costs
Intangibles
Not a problem
Changes in technology
Estimates of work/costings
Ensuring business units correctly code to nominal ledger
Complexity/flexibility of factory systems and technology
Accounting for all costs
None
Ensuring all costs have been identified up front
None
Validation, training and support costs
Difficult to predict beyond initial costs for support, integration etc.
Future obsolescence rate
User demand, training, changing technologies
Calculating net costs
Relating those costs to business benefits

Development time
Implementation deadlines not being made
Software development timings and costs
No formal charge out mechanism for computer services
End-user costs
Projecting timescale estimation
No real problems
Without workflow studies, indirect costs are difficult to estimate
Hidden costs - support staff costs
The rapidly changing technical environment

B. IT Benefits

IT Benefits (Problems)
Measurement & Evaluation metrics in general
Many of the benefits such as better customer service cannot be measured in £'s
Cannot always see the benefits - Technology change can propel an organisation forward, which cannot be measured in reduced costs or increased sales
Size of Company
IT benefits are often very difficult to quantify, because it is often unclear what the real benefits are
Intangibles
Measuring increased productivity
Changes in design during implementation - users unclear about requirements
Measuring value added to statistician
Constant change means when we review for benefits other factors come into play.
No major problems
Advanced measurement techniques and effort
Tangible benefits
Evaluating commercial use of additional information
Measuring the true tangible costs of inefficiencies that have been removed
Some benefits are intangible
Not a problem
Value of improved quality and customer service benefits
Benefits cannot be assessed in financial terms
No particular difficulty
Lack of any relevant/useable benchmarks

Headcount reduction, volume impact
Predicting the logistic effect that IT systems will have on the business - Bus charges
Intangible benefits
Assessing non-quantifiable benefits
What is the benefit of IT to the Business - How to measure the value it adds
Benefit never proven as no history full implementation audit. Role of business sponsor only recently defined to clearly make accountable for benefit
Management commitment
Re-organisational benefits re procedures, etc.
Not necessarily quantifiable in financial terms
Tend to be quantifiable over a long term
Value of information - how to assess
1.Benefits of application systems very difficult to quantify. Some are essential to the running of the business. others provide management information the use of which is difficult to quantify 2. desktop productivity difficult to measure due to PCs

6. Adequate understanding of IT cost/benefit issues among:

	Yes	Don't Know
IT Professionals	62.5%	10%
Line Managers	20%	22.5%
Top Management	37.5%	17.5%

7. Criteria Important to evaluating investments: Scale 5(very important) to 1(unimportant)

	5	4	3	2	1
Strategic Alignment	75%	20%	2.5%	0%	2.5%
IT Architecture	7.5%	37.5%	40%	12.5%	2.5%
Business Process Redesign	17.5%	35%	27.5%	17.5%	2.5%
Risk	7.5%	42.5%	42.5%	7.5%	0

8.

A. Application of standard investment appraisal methods to IT

Yes 52.5%

Some methods Used

If Yes, specify method
ROI
Linked to business objectives. Full cost benefit analysis. Payback period
ROI and evaluation of information improvement
Cost/benefit/ROI
All investment in IT must give tangible returns within 12 months
ROI, Cost avoidance, value added, process improvement, time to market
Value, IRR, NPV
Value added, cost saving
Net Present Value
ROI/CBA
Informal: But ROI approx. unless the project raises other issues
ROI is used to a limited extent
Economic Value Added

B. In-house method

Yes 25%

Some methods used

If Yes, specify in-house method
Budget for costs and monitor to budget. Agree benefits and time schedule as to where benefits will be seen. Track benefits against time schedules. Review benefits continuously
Appraisal considers non cash benefits also. There is no formal review of IT expenditure/benefits
Align to objectives, integrate with total business
Provided by our head office
Based on Corporate IT standards
Not specified
The operating benefits are measured

9. Effectiveness of investment appraisal methods: Scale 5 (very successful) to 1 (unsuccessful)

	5 Very successful	4	3 Successful	2	1 Unsuccessful
Effectiveness	2.5%	2.5%	57.5%	30%	7.5%

10.

A. Percentage of systems development projects that deliver expected , or above, targeted returns:

	0-25%	26-50%	51-75%	76-99%	100%
Targeted returns*	2.5%	25%	40%	25%	0

B. Percentage of systems development projects completed to budget:

	0-25%	26-50%	51-75%	76-99%	100%
Completed to budget*	2.5%	27.5%	30%	27.5%	5%

**Note: 7.5% of respondents did not complete this question*

References

[1] Drucker , Peter F. "Post-Capitalist Society", 1993 Oxford: Butterworth Heinemann
[2] Wriston, Walter "The Twilight of Sovereignty: How the Information Revolution is Transforming the World", 1992 NY: Scriben
[3] Rex Malik, "And Tomorrow, The World", 1975 London: Millington
[4] Paul Rolph and Peter Bartram, "The Information Agenda", 1994 Chalford, Glos.: Management books 2000, Rosabeth Moss Kanter, "The Change Masters", 1985 NY: Simon & Schuster
[5] Drucker, *ibid.*
[6] Tapscott, D. and Caston, A. "Paradigm Shift", 1993 NY: McGraw-Hill
[7] Cash, J.I., McFarlan, F.W., and McKenney, J.L., "Corporate Information Systems Management: The Issues Facing Senior Executives", 1992 Homewood, Ill.: Irwin
[8] Rolph and Bartram, *ibid.*
[9] Keen, Peter G.W., "Shaping the Future", 1990: Business Design through Information Technology. Boston, Mass.: Harvard Business School Press
[10] Kew Associates (1995) User IT Expenditure Survey 1995. Computer Weekly/Kew Associates
[11] Engardio, P. "Third World Leapfrog", Business Week, May 18, 1994 pp 47-49
[12] Keen, ibid.
[13] Figures originating from Morgan Stanley, quoted by Ian Dewis of the Cranfield IT Institute in a paper entitled "Managing IT Investment for Business Benefit" (proceedings from seminar "IT Investment Appraisal" London, 18/02/93).
[14] Willcocks & Lester "Evaluating the feasibility of Information Technology Investments" Oxford Institute of Information Management, 1993.
[15] Computerworld, *ibid.*
[16] Hochstrasser, B and Griffiths, C. "Controlling IT Investment; Strategy and management", 1991: London: Chapman Hall
[17] The dominance of finance based techniques is supported by a wide range of research material. A survey of 175 varied organisations in the Northeastern USA by Adolph Katz showed that approximately 70% of respondents "use one or more of the traditional accounting measures" Adolph Katz, "Measuring Technology's Business Value", *Information systems Management*, Winter 1993Vol. 10 No. 1 pp. 33-39. "The use of traditional cost benefit analysis techniques alone are most commonly used, leading to inadequate and misleading [outcomes]" Proceedings from "*EIS '93*" Business Intelligence Conference, London, June 1993, Farbey, Land and Targett found that such measures predominate "Evaluating Investments in IT", Barbara Farbey, Frank Land, and David Targett, Journal of Information Technology, 1992 June Vol. 7 No. 2, pp. 109-121
[18] Farbey et al, *ibid.*
[19] Remenyi, D. And Williams, B. "Some Aspects of Methodology for Research in Information Systems", Journal of Information Technology, (1995) 10 No. 3 pp. 191-201
[20] Benbasat, I, Goldstein, D.K., Mead, M., "The Case Research Strategy in Studies of Information Systems", MIS Quarterly, September 1987 Vol 11 N. 3, pp 369-386
[21] Kaplan and Duchon
[22] Cohen, l. And Mannion, L. "Research Methods in Education", 1989 New York: Routledge
[23] Brown, S. And McIntyre, D. "An Action Research Approach to innovation in centralised educational systems" European Journal of Science Education, 1981 (3).
[24] Baskerville, R. And Pries-Heje, J. "Grounding the Theory in Action Research", Proceedings of the 3rd European Conference on Information systems, Athens, Greece, 1995
[25] Susman, G. And Evered, R. "An Assessment of the Scientific Merits of Action Research" Administrative Science Quarterly, 23 (4) December 1978
[26] Frankfort-Nachmias, C. And Nachmias, D. Research Methods in the Social Sciences, 1992 London: Edward Arnold
[27] Frankfort-Nachmias, C. And Nachmias, *ibid*
[28] Strauss and Corbin
[29] Baskerville, R. And Pries-Heje, *ibid.*
[30] Bell, J. "Doing Your Research Project: A guide for first time researchers in education and social sciences", 1993 Milton-Keynes: Open Univ. Press
[31] The two phase perspective invariably sees the introduction of the PC and end-user computing as the delineator (Rolph and Bartram, ibid., Keen, ibid.) while Tapscott and Caston (ibid.) envisage a six phase evolution in software. The Butler Cox Foundation ("Strategic Alignment", Foundation Research Report, April 1992) envisage a four phase approach to these developments.
[32] Butler Cox *ibid.*
[33] Butler Cox, *ibid*, (Tapscott and Capston, *ibid.*)
[34] Glen Peters, "Evaluating Your Computer Investment Strategy, Willcocks, Leslie "Information Management: The Evaluation of Information Systems Investments", 1994 London: Chapman & Hall
[35] E Pluribus, Cougar, J. D., Computum, Harvard Business Review, September-October 1986 Vol. 64 No. 5 pp. 87-91
[36] Meyer, D and Boone, M. "The Information Edge", 1989 Homewood: Dow Jones-Irwin
[37] Cougar, *ibid.*
[38] Butler Cox, *ibid.*
[39] Osterman, P. "The Impact of Computers on the Employment of Clerks and Managers", Industrial and Labour Relations Review, 1986 Vol. 39 No. 2 pp. 175-186

[40] Primrose, P.L. "Investment in Manufacturing Technology", 1991 London: Chapman & Hall
[41] Parkville, Victoria. "The Relationship Between Investment in Information Technology and Firm Performance: A Study of the Valve manufacturing Sector", Information Systems Research, December 1992 University of Melbourne, Graduate School of Management
[42] Kearney, AT, Corporate Organisation and Overhead Effectiveness Survey, 1987
[43] Porter, M. "Competitive Advantage", 1985: Creating and Sustaining Superior Performance. London: Collier Macmillan
[44] Strassman, P.A., "Information Payoff", 1985: The Tranformation of Work in an Electronic Age. New York: Free Press
[45] Carlson, W. and B.McNurlin, "Basic Principles of Measuring IT Value" I/S Analyser, Oct. 1992 Vol. 30 No. 10, pp. 1-16
[46] Schwartz, P. and Sassone, P., "Is Management Technology Living Up to Its Promise", Business Forum, Fall 1984.
[47] Meyers, D. and Boone, M. "The Information Edge", 1989
[48] Meyers, D. and Boone, M. "The Information Edge", 1989 (Foreword)
[49] "Strategic Information Technology Investments: Guidelines for Decision Making", Eric Clemons and Bruce Weber, Journal of Management Information Systems, Fall 1990 Vol. 7 No. 2 pp. 9-28
[50] "Evaluating Investments in IT", Barbara Farbey, Frank Land and David Targett, Journal of Information Technology, (1992) Vol. 7 No. 2 pp. 109-121
A 1992 survey by the Irish National Institute for Management Technology confirms this finding [Report Title , National Institute for Management Technology, 1992
[51] This change has been identified by wide range of researchers. Tapscott and Capston, *ibid.*, Hammer and Champy, (Hammer, M. and Champy, J. "Reengineering the Corporation: A Manifesto for Business Revolution", 1993 NY: Harper Business), (Donovan, J.J. "Business Reengineering with Information Technology, 1994 Englewood Cliffs, N.J.: PTR Prentice Hall) and others
[52] Hammer, M. and Champy, J. "Reengineering the Corporation: A Manifesto for Business Revolution", 1993 NY: Harper Business
[53] Donovan, *ibid*, Tapscott & Capston, *ibid.*
[54] Chorafas, D.N., "Measuring Returns on Technology Investments; A Handbook for Management", 1993 Dublin: Lafferty Publications
[55] CSC Index Foundation Report No. 91 "Building the New Information Infrastructure", July 1993
[56] Peat Marwick, IT Survey among CEOs, 1989
[57] Willcocks, *ibid.*
[58] Hochstrasser, B. and Griffiths C. *ibid.*
[59] Quoted in a special I/S Analyser report, Carlson, W.M. and McNurlin, B.C., "Uncovering the Information Technology Payoffs", 1992 Rockville M.D.: United Communications Group
[60] Keen, *ibid.*
[61] Like most organisations, Ford at this time had a reciprocal arrangement with another company whose hardware configuration was virtually identical. This was to provide emergency processing in the event of a major disaster such as a fire. One such arrangement was with Cadbury's, the confectionery group, but agreements had to be signed with new companies as the hardware was upgraded, or the supplier changed. The cost/benefit analysis approach used by Ford was similar to that in these organisations, although more rigid in terms of cost and benefit definition.
[62] Ford and Cadbury, having identical installations, had a reciprocal backup arrangement with one another from 1971 to 1980.
[63] Paul Strassman. Proceedings at London seminar "Achieving Superior Corporate Performance with I.T." London, November 18, 1993
[64] Peter Keen, *ibid.*
[65] "Strategic Alignment", Butler Cox Foundation, Research Report 86, April 1992
[66] "Information Systems Strategic Planning", Charlestown S.C.: Computer Technology Research Corp. This report charts the transition from internally-focused IS departments during Phases and 2, to a gradual reaom internally-focused IS departments during Phases and 2, to a gradual realisation of the impact of strategic alignment, which is now, according to this and other surveys, one of the top issues for IS managers.
[67] Tibbets, J. And Bernstein, B. "Can PCs be Trusted?", Information Week, August 15, 1994
[68] Bray, P. "Networks: The Hidden Costs", Computerscope, January 1994
[69] Special Report on End-user Computing: Information Week, January 4, 1993
[70] Special Report on End-user Computing: Information Week, January 4, 1993
[71] Tibbets, J. And Bernstein, B., *ibid.*
[72] Bray, *ibid.*
[73] Healy, P. "Counting the Cost of Computing", Management, December, 1993
[74] Healy, *ibid.*
[75] The definitions, advantages and disadvantages of finance based appraisal techniques are drawn from the following: Vause, R. And Woodward, N. "Finance for Managers", 1981 Second Edition London: Macmillan, "Guide to Capital Investment Appraisal", Institute of Chemical Engineers, 1980, Strassman, P.A., "Information Payoff", 1985, and Herbst, A.F. "Capital Investing: Analysis and Strategies for Investment in Capital Assets" , 1990; NY, Harper Business. Hares, J. And Royle, D. "Measuring the Value of Information Technology", 1994 NY: Wiley
[76] Strassman, P.A., "Information Payoff", 1985
[77] Meyers and Boone, *ibid.*
[78] Strassman, P.A., "Information Payoff", 1985
[79] Keen, *ibid.*

[80] Vincent, David R. "The Information Based Corporation: Stakeholders, Economics and the Technology Investment", 1990 Homewood. Ill.: Dow Jones-Irwin
[81] Henderson J.C. and Curley, K.F. "Assessing the Value of Corporate Wide Human Resource Information System: A Case Study", Journal of Management Information Systems, Winter 1993, Kambil, A., J.C. Henderson, and Mohsenzadeh, H. "Strategic Management of Information Technology Investments: An Options Perspective" Sloan School of Management, Centre for Information Systems Research, 1990, Dos Santos, "Assessing the value of strategic information technology investments", Information Management ed. L. Willcocks, 1994. Cambridge, Mass.: Sloan School of Management Nolan, Norton & Co. "Stage by Stage", 1985
[82] Strassman, P.A., "Information Payoff", 1985
[83] Willcocks, *ibid.*
[84] Nolan and Norton, *ibid.*
[85] Earl, Michael J. "Management Strategies for Information Technologies", 1989. NY: Prentice Hall
[86] Keen, *ibid.*
[87]Mitch Betts "Shadow Spending Haunts IS", Computerworld, July 26, 1993, V. 27 N.30 pp 1,66
[88] Quoted from Mark Helper, "Mired in the PC Depreciation Bog", Computerworld, June 7, 1993, V. 27 N.23 p.24
[89] Nolan, Norton & Co. "Stage by Stage", 1985
[90] Clemons, E.K. Corporate strategies for information technology: a resources based approach Computer, November 1991. Also Clemons, E.K. and B.W. Webster, Strategiction technology infrastructure: Some empirical observations" in Perspectives in the Strategic and Economic Value of Information Technology Investment ed. Rajiv Banker, R. Kauffman and Mo Adam Mahmood, 1992
[91] Weill, P. "The role and value of information technology infrastructure: Some empirical observations" in *Perspectives in the Strategic and Economic Value of Information Technology Investment* ed. Rajiv Banker, R. Kauffman and Mo Adam Mahmood, 1992
[92] Henderson J.C. and Curley, K.F. "Assessing the Value of Corporate Wide Human Resource Information System: A Case Study", Journal of Management Information Systems, Winter 1993, Kambil, A., J.C. Henderson, and Mohsenzadeh, H. "Strategic Management of Information Technology Investments: An Options Per"Stage by Stage", 1985
[93] Sassone, P. "A survey of cost-benefit methodologies for information systems" *Project Appraisal, 1988*
[94] Keen, *ibid*
[95] "Measuring and improving IS performance", CSC Index, March 1992
[96] Katz, Adolph I., Measuring Technology's Business Value, Information Systems Management, Winter 1993 V 10, No.1 pp. 33-39
[97] Wilson, D. "Assessing IT Performance: What the Experts Say", MIT working paper from the '*Management in the 1990s*' project, 1988 Cambridge Mass.:L Sloan School of Management, Mass. Institute of Tech.
[98] Peters, Glen "Evaluating Your Computer Investment Strategy": *"Information Management: The Evaluation of Information Systems Investments"*, Ed. L. Willcocks, 1994
[99] Hochstrasser, B. "Justifying IT Investments"; *"Information Management: The Evaluation of Information Systems Investments"*, 1994)
[100] Datapro research Group, McGraw Hill, 1991
[101] Remenyi, D.S.J., Money,A. and Twite, A. "A Guide to Measuring and Managing IT Benefits" Second Edition, 1993 Manchester: NCC Blackwell
[102] Ward, M.J., "*Investment in IT: The Portfolio Approach*", CIMA, 1993 London: Chartered Institute of Management Accountants
[103] McFarlan, F.W., "Information Technology Changes the Way You Compete", Harvard Business Review, July/August, 1984
[104] Farbey, B., Land, F., and Targett, D.; "Evaluating Investments in IT", Journal of Information Technology, June 1992 V. 7 N. 2 pp. 109-121. Also by the same authors "How to Assess Your IT Investment: A Study of Methods and Practice", 1993 Oxford: Butterworth Heinemann
[105] Parker, M.M., and Benson, R.J., "Information Economics: Linking Business Performance to Information Technology", 1988 Englewood Cliffs N.J.: Prentice Hall
[106] Dervra Wiseman, a UK consultant in IT, has operationalised Information Economics in a number of companies in recent years ("Information Economics: A Practical Approach to Valuing Information Systems", *"Information Management: The Evaluation of Information Systems Investments"*, ed. L. Willcocks, 1994
[107] Strassman, P.A., "The Business Value of Computers", 1990 : An executives guide, New Cannon Conn.: Information Economics Press
[108] Strassman, P.A., "Information Payoff", 1985
[109] "The Business Value of Computers", *ibid.*
[110] "The Business Value of Computers", *ibid.*
[111] Sullivan-Trainor, M. "The New Team Approach with Users" Computerworld, Nov. 18, 1987
[112] Earl, M.J. "Management Strategies for Information Technologies, 1989 NY: Prentice Hall
[113] Ballantine, J.A., Galliers, R.D., Powell, P.D. "Daring to be Different: Capital Appraisal and Technology Investments" Proceedings of the 3rd European Conference on Information Systems, Athens, Greece, June 1-3, 1995, 1995
[114] Willcocks, L. And Margetts, H., "Risk and Information Systems: Developing the Analysis", 1994
[115] "Strategic Alignment", Butler Cox Foundation, Research Report 86, April, 1992
[116] Butler Cox Foundation, *ibid.*
[117] Butler Cox Foundation, *ibid.*

[118] Butler Cox Foundation, *ibid.*
[119] John Ward, Pat Griffiths and Paul Whitmore "Strategic Planning for Information Systems", 1990. The authors are quoting a Galliers survey which shows alignment to be very weak. NY: Wiley
[120] Ward et al, *ibid.*
[121] Marilyn Parker, Robert Benson with Edward Trainor, *"Information Economics: Linking business Performance to Information Technology"*, 1988 Englewood cliffs, NJ.: PrenticeHall
[122] "Say Goodbye to Strategic Planning", Akram Yosri, Computerworld August 30, 1993 V. 27 N. 35 p. 33
[123] Don Tapscott and Art Caston, "Paradigm Shift", 1993
[124]Donald Marchand and Forest Horton, Infotrends, 1986 Profiting from your Information Resources, NY: Wiley
[125] Keen, P.G.W., "Shaping the Future: Business Design Through Information Technology", 1991
[126] Wilson, I. "Strategic Planning Isn't Dead - It Changed", Long Range Planning, 27, 4 August 1994 V.27 N. 4 pp. 12-24
[127] Earl, *ibid.*,; I.T Strategy for Business, ed. Peppard, J. 1993 London: Pitman, McDonald, K.H., "Business Strategy Development, Alignment and Redesign", "The Corporation of the 1990s" (ed. Scott-Morton, M.S.) NY: Oxford University Press
[128] Ward et al, *ibid.*
[129] Wriston, W.B., "The Twilight of Sovereignty: How the Information Revolution is Transforming our World", 1992
[130] Drucker, P.F "Post Capitalist Society", 1993
[131] Wriston, *ibid.*
[132] Keen, P.G.W., "Shaping the Future: Business Design Through Information Technology", 1991
[133] Wriston, *ibid.*
[134] Keen, *ibid.*
[135] Ward, J., Griffiths, P., Whitmore, P. "Strategic Planning for Information Systems", 1992
[136] Ward, J., Griffiths, P., Whitmore, P., *ibid.*
[137] Drucker, *ibid.*
[138] Ward *et al, ibid.*
[139] David R. Vincent, *"The Information Based Corporation"*, 1990
[140] J. Rockart "Chief Executives Define their own Data Needs" *Harvard Business Review* 57, (March-April 1979)
[141] Earl, M.J. "Management Strategies for Information Technologies, 1989
[142] Vincent, *ibid.*
[143] Earl, *ibid.*
[144] Ward, J., Griffiths, P., Whitmore, P., *ibid.*
[145] Hearnden, K., *"A Handbook of Computer Security"*, 1990: London: Kogan Page
[146] Hickey, G. "Strategic IS/IT Planning" "Strategy for Business" ed. Peppard, J. London: Pitman 1993
[147] Lance B. Elliot 1991 survey by SIM, quoted in "Information Systems Strategic Planning", Charlestown S.C.:Computer Technology Research Corp
[148] Keen P.G.W. "Shaping the Future: Business Design Through Information Technology", 1991
[149] Moad, J., "Time for a Fresh Approach to ROI", *Datamation,* Feb. 15, 1995 V. 41 N. 3 pp. 57-59 also Willcocks, Leslie "Information Management: The Evaluation of Information Systems Investments", 1994, Coleman, T. And Jamieson, M. Beyond Return on Investment", 1994
[150] Michael E. Porter and Victor E. Millar "How Information Gives You Competitive Advantage", *Harvard Business Review,* July-August, 1985 V. 63 N. 4 pp. 149-160
[151] Meyers, D. and Boone, M. "*The Information Edge*", 1989
[152] "Parker, M.M., Benson, R.J. with Trainor, H.E. *"Information Economics"*, 1988
[153] Remenyi, D.S.J., Money, A., Twite, A. "A Guide to Measuring and Managing IT Benefits", 1993 Manchesdter: NCC Blackwell, Strassman, P.A., "The Business Value of Computers", 1990
[154] Remenyi, D.S.J., Money, A., Twite, A., *ibid.*
[155] Meyers and Boone, *ibid.*
[156] Strassman, *ibid*
[157] Vincent, D.R. "The Information Based Corporation", 1990, also Rockart, J. "Chief Executives Define Their Own Data Needs", Harvard Business Review, March-April, 1979
[158] Remenyi, D.S.J., Money, A., Twite, A., *ibid.*, Keen, P.G.W., "Shaping the Future: Business Design Through Information Technology", 1991
[159] Chorafas, D.N. "Measuring the Returns on Technology Investmwith Trainor, H.E. "Information Economics", 1988
[160] Willcocks, Leslie "Information Management: The Evaluation of Information Systems Investments", 1994
[161] Hares, J. and Royle, D. "Measuring the Value of Information Technology", 1994 NY: Wiley
[162] Willcocks, *ibid.*
[163] Strassman, *ibid*
[164] "Parker, M.M., Benson, R.J. with Trainor, H.E. "Information Economics, 1988
[165] Remenyi, D.S.J., Money, A., Twite, A., *ibid.*
[166] Kaye, David, "Gamechange", The Impact of IT on Corporate Strategies and Structures", 1990 Heinemann Newnes
[167] Johnston, Russell and Lawrence, P.R. "Beyond Vertical Integration - The Rise of the Value-Added Partnership", Harvard Business Review, July-August 1988 V. 66 N.4 pp 94-101
[168] Moriarty, R.T., and Swartz, G.S. "Automation to Boost Sales and Marketing", *Harvard Business Review*, September-October, Jan/Feb 1989 v. 67 N. 1 pp. 100-108
[169] Boynton, A.C. and Zmud, R.W., "Management Information Systems - Readings and Cases", 1990: A Managerial

Perspective. Glenviw, Ill.: Scott, Foresman
[170] Coleman, T. And Jamieson, M. *Information Systems: Evaluating Intangible Benefits at the Feasibility Stage of Project Appraisal.* Unpublished MBA thesis quoted in Willcocks *(ibid.)*. Earl, M.J. "Management Strategies for Information Technologies, 1989 and Drury, C. "Management and Cost Accounting", 1988 Second Edition London Chapman Hall
[171] *"The Corporation of the 1990s"*, ed. Scott-Morton, M.S., 1991 NY: Oxford U. P.
[172] Strassman, P. *Information Payoff"*, 1985: The author has undertaken consultancy assignments where overhead did not form part of either the investment appraisal or subsequent benefits analysis.
[173] Strassman [1985], *ibid.*
[174] Wriston, W.B., "The Twilight of Sovereignty: How the Information Revolution is Transforming our World", 1992
[175] Strassman, 1985, *ibid.*
[176] The author experienced this syndrome in a major way while heading the Economic Studies Dept. at the Ford Motor Co. in the 1970s. Armies of analysts studied revenues and costs in microscopic detail. No price increase would be sanctioned in the absence of inch-thick studies. More often than not, further and more detailed analysis was requested. Based on what economic indicators were available, precise sales forecasts, by month, by model line, and by derivative within model line, were called for - an exercise of total futility. The decision making process became increasingly sluggish and unresponsive, and it gradually became apparent that the decisions, when they did emerge from the morass, displayed a classical inability to distinguish the "wood from the trees". Yet British Leyland, one of Europe's largest car-manufacturers at the time, wanted even greater detail, to the extent of poaching huge numbers of the Ford analysts. This did not prevent the company's eventual dismemberment (some participants felt it contributed to it). Ford subsequently performed a U-turn in this area
[177] Willcocks, *ibid.*
[178] Norton, D. "A Case Study: Hercules Inc." Stage by Stage 1986
[179] Kieran Mathieson, "Techniques: Reducing bias in users' evaluations of information systems", Information and Management" Sept. 1993 V. 25 N. 3 pp. 165-171, Keen, *ibid.*
[180] Carlson, W.M. and McNurlin, B.C. "Uncovering the Information Technology Payoffs", 1992 Rockville M.D.: United communications Group
[181] Strassman, 1990, *ibid.*
[182] Strassman, 1990, *ibid.*
[183] Telephone conversation, May? 1993. Lodahl's claims were put to Strassman at a Conference in London in November, 1993. Strassman admitted the complexity, but added that with advances in activity based costing and associated computerised support, the problem would decline. He also claimed that over 100 companies were operating the method satisfactorily, and that his associate, Prof. Herber F. Spirer was extending it to include additional organisations.
[184] Lodahl, T. and Redditt, K., cited in Carlson, W.M. and McNurlin, B.C. *"Uncovering the Information Technology Payoffs"*, 1992
[185] Strassman's London Conference, *ibid.*
[186] Dan Remenyi and Arthur Money "A user-satisfaction approach to IS effectiveness", Journal of Information Technology Sept 1991 V. 6 N 3-4 pp. 165-175
[187] Remenyi, D. and Money, A. *ibid.*
[188] Mathieson, *ibid.*
[189] Carlson, Walter & McNunlin, Barbara, I/S Analyser October 1992. "Basic Principles for Measuring IT Value" V. 30 N. 10 pp. 1-6
[190] Part of the explanation for the low application of post rather than pre evaluations could be due to fear by participants of the findings. In 1988 the author had developed an investment appraisal software package. It incorporated several features for performing post implementation assessments on how the project was performing against plans. These were seen to be a major selling point. They turned out to be, in fact, a deterrent to sales, particularly amongst the engineering profession. Eventually the sales team decided to omit any reference to such features. The favourable impact on sales soon became apparent!
[191] Richard T. Due "The Productivity Paradox", Information Systems Management, Winter, 1993 V10 N.1, pp 68-71
[192] Due, *ibid.*
[193] The findings and opinions in this section are a composite deriving from an In Depth review of benchmarking in the December 20, 1993 edition of *Computerscope* ("Benchmarking on Empty"), "Uncovering Information Technology Payoffs", Carlson & McNurlin, 1992, (Drew, S. "BPR in Financial Services: factors for Success", *Long Range Planning*, October 1994 V. 27 N.5 pp 25-41), the author's own consultancy experiences,
[194] "Shadow Spending Ha", Mitch Betts, Computerworld, July 26, 1993 v. 27 N. 30 pp 1,66
[195] Betts, *ibid.*
[196] Hammer & Champy "Reengineering the Corporation - A Manifesto for Business Revolution", 1993, Wriston "The Twilight of Sovereignty", 1992, "Paradigm Shift", Tapscott & Capston, *ibid.*
[197] Peppard, J. And Rowland, P. "The Essence of Business Process Re-engineering", 1995 NY Prentice Hall, Tapscott and Caston, *ibid.*
[198] Hammer, M. and Champy, *ibid.*
[199] Tapscott & Capston, *ibid.*
[200] Scott Morton, M.S., "The Corporation of the 1990s", Keen, P.G.W., "Shaping the Future: Business Design Through Information Technology", 1991
[201] Hammer & Champy, *ibid.*
[202] Hammer & Champy, *ibid.*
[203] Applegate, Cash and Quinn Mills "Information Technology and Tomorrow's Manager" Harvard Business Review,

November-December 1988 V 66 N. 6, pp 128-136
[204] Author's experience of management in the IT and finance activities
[205] Hammer & Champy, *ibid.*
[206] Wriston, *ibid.* In identifying this trend, Wriston cites the example of the microchip, of which labour and raw material account for less than 10% of the gross cost.
[207] Author's experience in several divisional and geographical locations with Ford of Europe showed that Ford encouraged a 'confrontation culture' which was seen as a stimulant to activity.
[208] Peppard, J. And Rowland, P. *ibid.*
[209] These, and other well-known cases, have been cited by Keen, Strassman and others.
[210] Keen, P.G.W., "Shaping the Future: Business Design Through Information Technology", 1991
[211] Chorafas, D.N. "Measuring Returns on Technology Investments", 1993
[212] Keen, *ibid.*
[213] Hammer & Champy *ibid.*
[214] Keen, *ibid.*
[215] Peppard and Rowland, *ibid.*
[216] Drucker, P.F. "Post Capitalist Society", 1993
[217] Peter Bartram, "Business Reengineering - The Use of Process Redesign and I.T. to Transform Business Performance" 1992 London: Business Intelligence
[218] Hammer & Champy, *ibid.*
[219] Peppard and Rowlands, *ibid.*
[220] Peter Drucker "Obsvations of an Bystander" CSC Insights, Fall 1991
[221] CSC Index Report 79, "The Role of IT in Transforming the Business", Conference "Business Reengineering, The Use of Process Redesign and IT to Transform Corporate
Performance".
[222] Hammer & Champy *ibid.*
[223] Tapscott, D. And Caston, A. *ibid.*
[224] Strassman, P. "Reengineering: An Emetic in a Perfume Bottle?" Computerworld, August 16, 1993. V. 27 N. 3, pp. 33
[225] Earl, M. And Kahn, B. "How New is Business Process Redesign?" European Management Journal, March, (1994) V. 12, No. 1 pp. 20-30
[226] Hall, G., Rosenthal, J. and Wade, J. "How to Make Reengineering Really Work", Harvard Business Review, November-December, 1993. V. 71 N. 6 pp. 119-131
[227] Strassman, *ibid.*
[228] "Profiting for Legacy Systems" M.A.C.E., 1994 Anstg, West Sussex: MACE
[229] "Legacy Systems, Legacy Options", Computerworld, July 11, 1994
[230] Davenport, T. "Don't Forget the Workers", *Information Week*, August 8, 1994
[231] Jain, Shailandra, "Transcending Functional Boundaries", *Computerworld*, May 30, 1994 Sept. 30 V 28 N 36 P 35
[232] Hammer & Champy, ibid.
[233] Hammer & Champy, ibid.
[234] Peppard and Rowlands, *ibid.*
[235] Venkatraman, N. "IT-Induced Business Reconfiguration", The Corporation of the 1990s, ed. Scott-Morton, M.S., 1991
[236] Donovan, J. "Business Reengineering with Information Technology", 1994
[237] Bartram (*ibid.*) lists the following IT contributions:
- Data collection, analysis, storage, delivery and sharing techniques.
- Distance shrinking (linking remote team members, eliminating information intermediaries).
- Tracking the progress of work tasks
- Knowledge provision, such as expert systems and decision support systems.

[238] Teng, T.C., Grover, V. And Fiedler, K.D., "Redesigning Business Processes Using Information Technology", Long Range Planning, February 1994 V 27 N1 95-106
[239] Teng, et al, *ibid.*
[240] Hammer andhampy, *ibid.*
[241] Hammer and Champy, *ibid.*
[242] Donovan, *ibid*
[243] Donovan, *ibid.*
[244] Donovan, *ibid.*
[245] Davenport, T. And Short, J. "The New Industrial Engineering: Information Technology and Business Process Redesign" Sloan Management Review, Summer 1990 V. 31 N. 4 pp. 11-27
[246] Davenport, *ibid.*
[247] Roach, S.S., "Services Under Siege - The Restructuring Imperative", Harvard Business Review, September-October, 1991 V. 69 N. 5 pp. 82-91
[248] Lederer, A.L., and Mirani, R. "Anticipating the Benefits of Proposed Information Systems" ,Journal of Information Technology, September 1995 V. 10 N. 3 pp. 159-169
[249] "Parker, M.M., Benson, R.J. with Trainor, H.E. "Information Economics, 1988
[250] Michael J. Earl "Management Strategies for Information Technology", 1989, 20
[251] Allen, B. "Make Information Services Pay its Way", Harvard Business Review, January-February, 1987 V. 65 N. 1 pp. 57-

[252] Edwin Tozer "Strategic IS/IT Planning", Newton M.A.: Butterworth Heinemann. "Strategy for Business" ed. Peppard, J. 1993 London: Pitman
[253] "IT Strategy for Business", Peppard et al. ,56
[254] Keen, P.G.W., "Shaping the Future: Business Design Through Information Technology", 1991
[255] Wriston, W.B., "The Twilight of Sovereignty: How the Information Revolution is Transforming our World", 1992
[256] Donald A. Marchand and Forest W. Horton, "Infotrends", 1986: Profiting from your Information Sources, NY: Wiley
[257] Newcomb, J. "The End of Forest W. Horton, *ibid.*
[259] Irving D. Canton "Learning to Love the Service Economy" Harvard Business Review, May-June 1984 pp.89-97
[260] Peter G.W. Keen, "Shaping the Future", 1991, 194
[261] Peter G.W. Keen, *ibid.* 8
[262] Wriston, *ibid.*
[263] Computer Technology Research Corp. "Information Systems Strategic Planning", 1991 Charleston S.C: Compter Technology Research Corporation
[264] "Copying a Key Strategy: Xerox weighs $6.5 billion out", Information Week, September 20, 1993
[265] Prince, T.E. "Open Systems: A bad idea even if they were possible" Computerworld, April 19, 1993
[266] Prince, *ibid.*
[267] A. Radding and J. Maglitta, "Techno Renaissance", Computerworld, April 26, 1993 V. 27 N. 17 pp. 67-72
[268] Willcocks, Leslie "Information Management: The Evaluation of Information Systems Investments", 1994
[269] Computer Technology Research Corp. *ibid.*
[270] Computer Technology Research Group "Downsizing for cost-effective Enterprise Computing", 1993 Charleston S.C: Compter Technology Research Corporation
[271] Lobel, *ibid.*
[272] Gartner Group, February, 1995
[273] "Apples and Orangutangs: Legacy Systems and Client Server", *Computerworld,* May 3, 1993
[274] Butler Cox Foundation Report 86, April 1992 "*Strategic Alignment*". This would broadly correspond with Computerworld's definition ("Apples and Orang-utans") *Computerworld,* May 3, 1993. Whereas non-critical applications should logically qualify as legacy, moving from them presents a different set of problems.
[275] *Information Week,* May 24, 1993. Special Report on Legacy Systems.
[276] Figures quoted in (ibid.) most drawn from research by G2 Research Inc.
[277] Tapscott, D. and Caston, A. "Paradigm Shift: The New Promise of Information Technology", 1993, Keen, *ibid.*
[278] Michael Kennedy & Andrew Gurbascani "When Client/Server isn't Right", Computerworld, April 19, 1993 V. 27 N. 16 pp. 99-101
[279] D. Trimmer, "Downsizing: Strategies for Success in the Modern Computer World",1993 Reading Mass.: Addison Wiley
[280] David Smith, a Vice Prnsultinesident in the IBM Consulting Group, quoted in Information Week *ibid.* Reading Mass.: Addison Wiley
[281] "When Client/Server isn't Right", Computerworld, *ibid.*
[282] "The Dinosaur Myth", Xephon, 1992
[283] "The Dinosaur Myth", *ibid.*
[284] "When Client/Server isn't Right", Computerworld, *ibid.*
[285] Edelstein, H., "Integration Strategies: Benefits Outweight the Costs", Computerworld, May 3, 1993 V. 27 N. 18 pp. 119
[286] D. Smith, *ibid.*
[287] Lodahl, T.M., and Redditt, K.L. "Benchmarking Effectiveness", Information Week, October 26, 1992
[288] Lincoln, T., "Managing Information Systems for Profit", 1990 NY: Wiley
[289] Lincoln, *ibid.*
[290] Tony Gunton "Inside Information Technology", 1990, 22; A Practical Guide to Management Issues, NY: PrenticeHall
[291] Edelstein, *ibid.*
[292] "A Paradox for Middle Managers", *Information Week*, October 11, 1993
[293] Cash, J., McFarlan, W. And McKenney , J. *Corporate Information Systems Management,*: the issues facing senior executives. 1992. Homewood, Ill., Irwin.
[294] Marais, C., "Should IS be Centralised or Decentralised?" Computerworld, November 27, 1995 V. 29 N. 48 pp. 96, 100, Healy, *ibid.*
[295] Donovan, J.J. "Business Reengineering with Information Technology, 1994; Lieberman, S., "Should IS be Centralised or Decentralised?" Computerworld, November 27, 1995 V. 22 N. 48 pp. 97-100
[296] Tapscott & Caston, *ibid.*
[297] Bannister, F. "Open Systems: Making Strategy Decisions about an Emerging Technology", IT Strategy for Business, ed. J. Peppard, 1993
[298] Institute of Electronic Engineers, quoted in *The Downside of Downsizing,* Xephon, 1994. Lewisville, TX.: Xephon
[299] Keen, *ibid.*, Tapscott and Capston, *ibid.*
[300] Healy, M., "IT Productivity and Counter-Productivity: Delivering Effective End-User Business Systems, Seminar, University College Dublin, October 6, 1993; Keen, *ibid.*
[301] Healy, *ibid.*
[302] Computer Technology Research Corp. "Information Systems Strategic Planning", 1991
[303] The Downside of Downsizing, Xephon, 1994, The Dinosaur Myth, (Second Edition, Xephon Group (no date on publication)

[304] The Dinosaur Myth, *ibid.*
[305] Hamilton, D. "Stop Throwing Hardware at Performance", Datamation, October 1, 1994 V. 40 N. 19 pp. 43-44, Healy, *ibid.*, The Downside of Downsizing, *ibid.*
[306] Lynch, D. "Share and Share Alike, Computerworld, July 12, 1993 V. 27 N. 28, pp. 115-116, Edelstein, H. "Benefits Outweigh the Costs", Computerworld, May 3, 1993 V. 27 N. 18, pp. 119, Chorafas, D.N., "Measuring Returns on Technology Investments; A Handbook for Management", 1993
[307] "Establishing a Client/Server Framework", I/S Analyser, November 1993 V. 31 N. 11, pp. 1-18
[308] Atre, Shaku & Storer, Peter "Client/Server Tell-all", Computerworld, January 18, 1993 V. 27 N. 3 pp. 73-75
[309] Tapscott & Caston, *ibid.*
[310]Chorafas, D.N.,("Measuring Returns on Technology Investments; A Handbook for Management", 1993) and Tapscott and Caston (*ibid.*) and Edelstein ("Benefits Outweigh the Costs", *Computerworld,* May 3, 1993) argue that moving to client/server generates cost savings, while Kennedy and Gurbansky ("When Client/Server isn't Right", *Computerworld,* April 19, 1993), Healy (*ibid.*), and various *Xephon* publications (see above) support the view that it actually costs more.
[311] Object Technology: Object Oriented Programming, I/S Analyser, December 1993 V. 31 N. 12, pp. 1-15
[312] "Looking for the Leading Objects", Informatics, July, 1993
[313] DataPro, McGraw Hill Productions "Object Management Group Common Object Request Broker", 1992
[314] Quoted in Object Technology: Object Oriented Programming, I/S Analyser, December 1993
[315] Michael Vizard "Object Technology: Ready to Fly?", Computerworld, December 13, 1993; V. 27 N. 50 pp. 37, 42
[316] Object Technology: Object Oriented Programming, I/S Analyser, December 1993,
[317] Laudon K. and Loudon J. Management Information Systems: A Contemporary Perspective, 1991 NY: Macmillan
[318] Willcocks Leslie and Helen Margetts. "Risk and Information Systems: developing the analysis" in "Information Management", ed. Willcocks, 1994.
[319] Strassman "The Business Value of Computers", 1990
[320] Willcocks, 1994, *ibid.*
[321] ICL colloquium on Risk at the Centre for Software Engineering, Dublin, September 21, 1993
[322] Griffiths, C. And Willcocks, L. "Evaluating Risk in Major IT Projects", "Hard Money- Soft Outcomes", ed. Farbey B., Targett D. And Land, F. 1995 Henley on Thames, Oxon.: Alfred Waller Ltd.
[323] Pike R. and Ho, S. "Risk analysis in capital budgeting: barriers and benefits" Omega 19
[324] Willcocks, L. And Margetts, H., "Risk and Information Systems: Developing the Analysis", 1994, Earl, M.J. "Management Strategies for Information Technologies, 1989, Bessant, J. "The Lessons of Failure: Learning to Manage New Manufacturing Technology: Diffusion, Implementation and Management", 1993 International Journal ofTechnology Management V8 N 3-5 pp 197-215. Ward, J.M., "Investment in T: The Portfolio Approach", CIMA, 1993
[325] "Strategic Alignment", Foundation Research Report, April 1992
[326] Earl, *ibid.*
[327] Tapscott, D. and Caston, A. "Paradigm Shift", 1993
[328] Hochstrasser, B. And Griffiths, C. "Controlling IT Investments", 1991, Pike and Ho. *ibid.*
[329] Tapscott and Caston, *ibid.*
[330] Grindley, K.
[331] Cash, J., McFarlan, W. And McKenney , J. Corporate Information Systems Management, 1992, Ward, *ibid.*
[332] Frederick P. Brooks "The Mythical Man-Month", Datamation, December 1974. Reading Mass.: Addison Wesley
[333] The study, conducted at ICL's Manchester location, is cited by Brooks, *ibid*
[334] Ward, *ibid.*
[335] Ward, *ibid.*
[336] Griffiths, C. And Willcocks, L., *ibid.*
[337] Maglitta, J. "Architectural Digress", *Computerworld,* April 18, 1994 V 28 N 16 pp 119-121
[338] Leslie Willcocks *et al, "Information Management: The evaluation of information systems investments"*, 1994
[339] ICL colloquium on Risk at the Centre for Software Engineering, Dublin, September 21, 1993
[340] Griffiths and Willcocks, *ibid.*
[341] Griffiths and Willcocks, *ibid.*
[342] C. James Bacon, cited in Willcocks *et al, ibid.*
[343] Willcocks and Margetts, *ibid.*
[344] Berliner, C. And Brimson, J. "Cost Management for Today's Advanced Manufacturing", 1988 Boston: Mass.: Harvard Business School Press
[345] Amongst those for whom a system of scoring and/or weighting form a central part of their approach are Glen Peters, "Evaluating Your Computer Investment Strategy, Willcocks, Leslie "*Information Management: The Evaluation of Information Systems Investments*", 1994; Nolan, Norton & Co. *"Stage by Stage"*, 1985, Ward, M.J., "*Investment in IT: The Portfolio Approach*", CIMA, 1993
[346] "Parker, M.M., Benson, R.J. with Trainor, H.E. "Information Economics, 1988
[347] Remenyi, D.S.J., Money, A., Twite, A. "A Guide to Measuring and Managing IT Benefits",
[348] Strassman, P.A., "The Business Value of Computers", 1990
[349] Serafeimidis, V. And Smithson, S. "The Management of Change for a Rigorous Appraisal of IT Investment: The Case of a UK Insurance Organisation"; *Proceedings of the 3rd European Conference on Information Systems, Athens, Greece, June 1-3, 1995*
[350] Ward, J.M., "*Investment in T: The Portfolio Approach*", CIMA, 1993

[351] Vaid-Rezada, V.K., "Incorporating of Intangibles in Computer Selection Decisions" *Journal of Systems Management*, November, 1983
[352] Money, A., Tromp, D., and Wegner, T. "The Quantification of Decision Support benefits Within the Context of Value Analysis", *MIS Quarterly*, June 1988 V. 12 N. 2 pp 223-236
[353] Coleman, T. and Jamieson, M., *"Beyond Return on Investment: evaluation all the benefits of information technology"*
[354] 1994, Hares and Royle, *ibid.*,
[355] *Strategic Alignment*, Butler Cox Foundation, Research Report 86, 1992
[356] Hares, J. and Royle, D. "Measuring the Value of Information Technology", 1994
[357] Willcocks, Leslie "Information Management: The Evaluation of Information Systems Investments", 1994, Keen, P.G.W., "Shaping the Future:Business Design Through Information Technology", 1991, Strassman, P.A., "The Business Value of Computers", 1990
[358] Primrose, P.L., *"Investment in Manufacturing Technology"*, 1991 NY: Chapman Hall
[359] Weill, P. "The role and value of information technology infrastructure: Some empirical observations" in *Perspectives in the Strategic and Economic Value of Information Technology Investment* ed. Rajiv Banker, R. Kauffman and Mo Adam Mahmood, 1992; Henderson J.C. and Curley, K.F. "Assessing the Value of Corporate Wide Human Resource Information System: A Case Study", *Journal of Management Information Systems, Winter 1993*, Kambil, A., J.C. Henderson, and Mohsenzadeh, H. "Strategic Management of Information Technology Investments: An Options Perspective" Sloan School of Management, Centre for Information Systems Research, 1990; "Measuring and improving IS performance", CSC Index, March 1992
[360] CSC Index Foundation Report No. 91 "Building the New Information Infrastructure", July 1993
[361] Farbey, B., Land, F. and Targette, D. "Evaluating Investments in IT", Journal of Information Technology (1992), 7, also "How to Assess Your IT Investment:A Study of Method and Practice", 193
[362] Ballantine, J.A., Galliers, R.D., Powell, P.D. "Daring to be Different: Capital Appraisal and Technology Investments" *Proceedings of the 3rd European Conference on Information Systems, Athens, Greece, June 1-3, 1995*
[363] Lumby, S.P., *Investment Appraisal*, 1984. Wokingham: Van Nostrand Reinhold
[364] Perrow, C. "The Analysis of Goals in Complex Organisations" *American Sociological Review*, 26, 1961. Ezzamel, M. And Hart, H. "*Advanced Management Accounting; An Organisational Emphasis*", 1987 London: Cassell
[365] Earl, Michael J. "*Management Strategies for Information Technologies*", 1989.
[366] Ballantine *et al.*
[367] Hochstrasser, B and Griffiths, C. "Controlling IT Investment; Strategy and Management", 1991
[368] Herbst, A.F. "Capital Investing", 1990
[369] Vause, R. And Woodward, N. "Finance for Managers", 1981 London: Macmillan
[370] Parker and Benson, *ibid.*
[371] Hertz, D. "Risk Analysis in Capital Investment" *Harvard Business Review*, Jan-Feb 1964.
[372] Martin, R.L. "The End of Delegation? Information Technology and the CIO", *Harvard Business Review*, September-October, 1995 V. 73 N. 5 pp 161-172
[373] Keen, Peter G.W., *"Shaping the Future"*, 1990, Strassman, *ibid*, Willcocks, *ibid.*
[374] Weill and Curley, *ibid.*
[375] Hay, M., and Williamson, P. *The Strategy Handbook*, 1991 Oxford: Blackwell
[376] Kearney, A.T., *"The Barriers and Opportunities of Information Technology - a Management Perspective"*, 1984 Orpington Kent: Institute of Administration Management and the Department of Trade and Industry, Willcocks, Leslie "Information Management: The Evaluation of Information Systems Investments", 1994, Hares, J. and Royle, D. "Measuring the Value of Information Technology", 1994
[377] Hares and Royle, *ibid.*
[378] Cash, J., McFarlan, W. And McKenney , J. *Corporate Information Systems Management*, 1992
[379] Keen, *ibid.*
[380] Cash, J.I., McFarlan, F.W., and McKenney, J.L., *"Corporate Information Systems Management: The Issues Facing Senior Executives"*, 1992
[381] Karten, N., "Mind Your Business: Strategies for Managing End User Computing", 1990 Wellesley, Mass.: QED Information Sciences
[382] Hammer, M. and Champy, J. "Reengineering the Corporation: A Manifesto for Business Revolution", 1993
[383] Hammer & Champy, *ibid.*
[384] Tapscott, D. and Caston, A. "Paradigm Shift: The New Promise of Information Technology", 1993
[385] Keen, P.G.W., "Shaping the Future: Business Design Through Information Technology", 1991
[386] Keen, *ibid.*
[387] Tapscott & Caston, *ibid.*, Hammer & Champy, *ibid.*
[388] Hammer & Champy, *ibid.*
[389] Willcocks, Leslie "Information Management: The Evaluation of Information Systems Investments", 1994
[390] Willcocks *et al*, *ibid.*