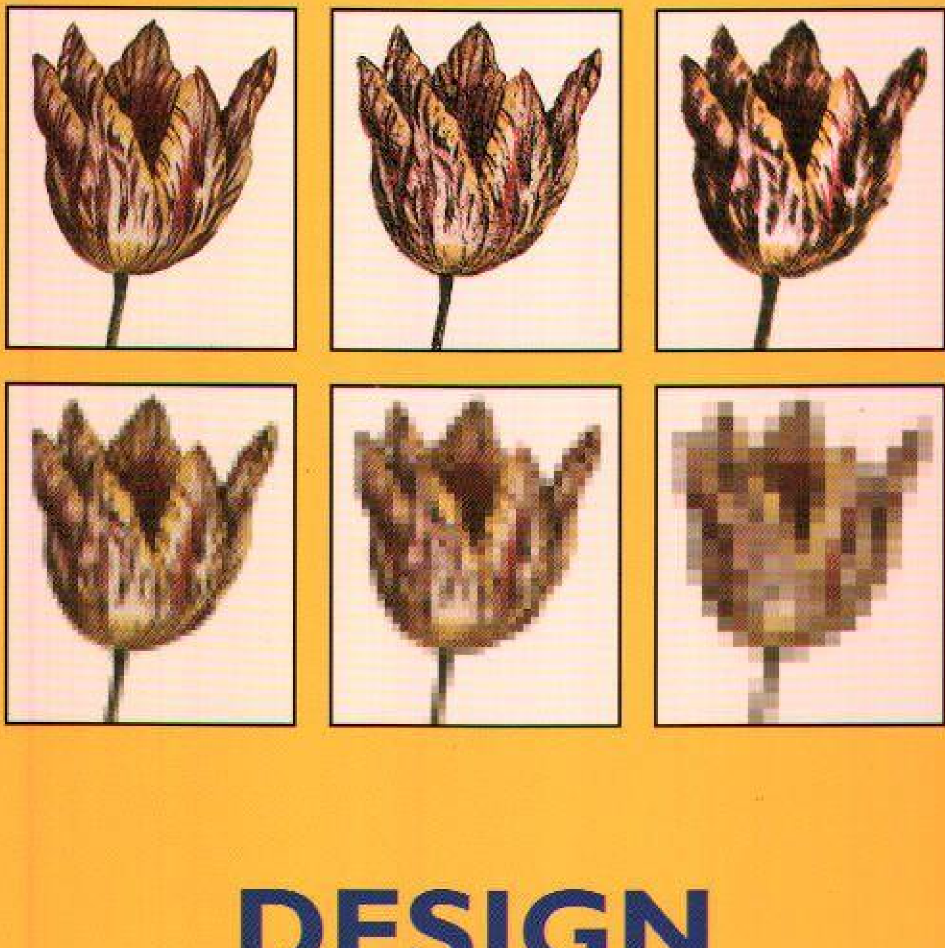
Eric VAN Heck



DESIGN MANAGEMENT OF EDI SYSTEMS

STELLINGEN

1. De ontwerpmanagement theorie voor EDI systemen is falsificeerbaar en bruikbaar in het verklaren van het succes van het EDI systeemontwerp.

   Dit proefschrift.

2. Het niveau van het ontwerpmanagement van EDI systemen is met name bepaald door het niveau van het management van het ontwerpproces, de aandacht die geschonken wordt aan aspecten van het EDI systeem, de relatie met het topmanagement en de relatie tussen ontwerpers en gebruikers.

   Dit proefschrift.

3. Bij het hanteren van internationale berichtenstandaarden voor elektronische berichtenuitwisseling, zoals bijvoorbeeld EDIFACT, dient men er rekening mee te houden dat deze standaarden weinig uitsluitsel geven over de semantiek en pragmatiek van de uit te wisselen gegevens.

   Dit proefschrift.

4. De, in het onderzoek gehanteerde, combinatie van kwantitatieve en kwalitatieve onderzoeksmethoden is bruikbaar voor het onderzoeken van factoren die het succes van het ontwerp van EDI systemen kunnen verklaren.

   Dit proefschrift.

5. Projectleiders van EDI projecten hechten ongeveer twee keer zoveel belang aan het kwaliteitsniveau van het ontwerp van het EDI systeem dan aan de kosten of het levertijdstip.

   Dit proefschrift.

6. Een gebrek aan falsificeerbare en bruikbare theorieën met betrekking tot het ontwerpen van informatiesystemen is een van de hoofdoorzaken waarom Bestuurlijk Informatiekundigen nog niet kunnen verklaren waarom informatiesystemen falen danwel succesvol zijn.

7. Het besturingsmodel is bepalend voor het informatieplan.

   J.M. Bots, E. van Heck, A.A. Kampfraath (1989), Het besturingsmodel is bepalend voor het informatieplan, *Informatie*, 31, 11, 829-836.

8. Het feit dat mensen op een dwaze manier besturen kan voor een belangrijk deel worden verklaard uit de eigenschap van mensen om zichzelf te beschermen tegen afwijkende informatie. Dit fenomeen staat bekend als cognitieve dissonantie.

   Barbara Tuchman (1988), *De Mars der Dwaasheid: Bestuurlijk onvermogen van Troje tot Vietnam*, Agon, Amsterdam.

9. Turbulentie in de zon, zichtbaar als zonnevlekken op het zonneoppervlak met een cyclus van ongeveer 11 jaar, heeft, via een invloed op het klimaat op aarde, een statistisch aantoonbaar effect op de mondiale landbouwproduktie.

   G. van Dijk, E. van Heck, C. Kruyt (1989), Zonnevlekken en landbouwproduktie: Nieuwe relaties bij oude speculaties, *Landbouwkundig Tijdschrift*, 101, 5, 16-20.

10. Wetenschappers zijn als artiesten. Zij vormen vanuit creatieve ideeën een theorie. Praktijk-georiënteerde mensen beslissen of het kunstwerk succesvol zal zijn.

    Lia Persoons.

11. Stellingen hebben bij Nederlandse proefschriften veelal de vorm van errata, zij worden op een los velletje bijgevoegd. Bij sommige proefschriften hebben zij ook de functie van errata.

Eric van Heck
Design Management of Electronic Data Interchange Systems
Wageningen, 17 November 1993

DESIGN MANAGEMENT

OF

ELECTRONIC DATA INTERCHANGE SYSTEMS

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DESIGN MANAGEMENT

OF

ELECTRONIC DATA INTERCHANGE SYSTEMS

Hendricus Wilhelmus Gerardus Maria van Heck

Proefschrift

ter verkrijging van de graad van doctor
in de landbouw- en milieuwetenschappen
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CONTENTS

1 INTRODUCTION

1.1 Motivation

Design is one of the most fascinating activities known to man. Architects design skyscrapers, composers design their symphonies, the engineer designs a compact disc and the system architect designs an information system. Design as a process can be defined as to create, fashion, execute, or construct according to a plan. Design, as the product of the design process, can be defined as a preliminary sketch or outline showing the main features of something to be executed.

Although design is one of the most fascinating of human activities it is little understood. How was the creative idea for the design of the Empire State building conceived, why did Mozart design his beautiful symphonies, how did that anonymous engineer design the compact disc, how do system architects design information systems, why is one design nicer, better, more usable than another? Underlying those questions there are other questions related to issues like: can we stimulate creative ideas, is it possible to initiate, direct and control design activities, if we manage those activities do we lose our creativity and become engulfed in bureaucracy? Answers to those questions are difficult to find. In this study answers were looked for by exploring theory and practice.

Practice
In this study the design process of information systems and the product of that process will be investigated. More specifically a particularly subset of information systems so-called Electronic Data Interchange (EDI) systems will be investigated. An EDI system is an information system which exchanges electronically structured and normative data between computers of transaction-related organizations. This definition can be further clarified by giving an exact definition of the terms used:

- *Structured and normative data*. The exchange of data is defined by a careful definition of the exchanged data. Data is structured into messages. A precise definition has to be given for each item of data.
- *Interchange between computers*. The automatic generation, communication and processing of data between computers is the key element in EDI. To be more precise, it is better to define it as the interchange between applications, because if organizations do not integrate EDI when it is applied internally, then they are not making optimal use of it.
- *Transactions-related organizations*. EDI is related to the exchange of data between computers of independent organizations. Data exchange supports the exchange of products/services between those organizations.

EDI facilitates the integration of intra-organizational information systems for the participating organizations. System integration integrates different information providers, system tasks, technologies, subject areas, information sources, user groups, but more important, integrates decision processes in and between organizations, see Beulens (1991), Bots et al. (1990); Kampfraath (1990); Penzias (1991); Schiefer (1992); and Zuurbier (1991). Before those EDI systems are implemented and operational they have to be initiated, designed and built. The design of an EDI system is based on an architectural model or a formal specification of an EDI system. Within the next four years, there will be an explosion in the growth of the European EDI market: in 1990 the total value of products and services amounted to 86 million dollars, for 1994 the projected figures are 396 million dollars (Computerworld 1990). Just recently, more attention has been given to research on EDI systems, see for example Benjamin et al. 1990; Bemelmans and Kreuwels 1990; Dankbaar 1991; Hofman 1989; Sokol 1989; Sol et al. 1990; Streng et al. 1992; Van Heck et al. 1991; and Venkatraman and Kambil 1991.

Not all creative ideas become reality. Some ideas lead to brilliant products: some turn out to be a disaster. Skyscrapers collapse, symphonies are never played, airplanes crash. These disasters are equally numerous in the world of information technology (IT), see Oonincx (1982); Roos (1991); and Paans (1992). Some mishaps are well known and worth a mention. In the Netherlands, for example, the development of an information system to provide students' monthly grants lead to enormous chaos (De Hart et al. 1987).

The development of information systems has usually been organized and carried out in the form of projects (Bots et al. 1990). Typically these projects:

- have been significantly late (when compared to planned completion dates);
- have exceeded the initial budget by more than 25% (and sometimes by even more than 200%);
- have supplied products which have had less than the expected functionality;
- have supplied products which have had quality problems which have seriously reduced the effectiveness and usability of these products;
- and, in addition, an unacceptably high number of these projects have failed to deliver usable products (Turner 1990).

At the first National EDI congress in the Netherlands in 1990, managers, designers and users of EDI systems were optimistic. But failures were also reported in the development stages of EDI systems. For example Kubicek (1992) reported difficulties in the development of the German banking business system called 'Electronic Cash'. The system handles electronic payment carried out by means of machine-readable cards at the point of sale which are then authorized and cleared in a network between the retail trade and the banking business. This is an example of Electronic Funds Transfer at Point Of Sale (EFTPOS). Kubicek (1992:30) reported that:

> *'After a history of more than 10 years during which still further system alternatives .. have been developed and tried in field tests, it is extremely uncertain whether the electronic cash system can still be implemented on a broad basis in the trade.'*

Also Mehler (1991) reported some major failures related to the (external) integration of information systems in the United States. He indicated that system integrators need constant monitoring and quality assurance. Also, he observed that system integrators in an interorganizational context ignored the most basic rules of project management. Konsynski (1992) argued that EDI plays a critical role in intra and inter-organizational integration. The sharing of business processes, technology interconnection and management control creates significant interdependencies that require planning. Management needs to play a significant role in the development and maintenance of policy that relates to electronic linkages involved in relationships with suppliers, customers, and competitors.

It would seem that the first optimistic opinions have been tempered. The design of EDI systems is not easy. Many organizations, with many representatives, are involved. Each of them with its specific vocabulary and semantics. Communication between those actors is difficult. The answer to the question of how to manage these processes seems to be far removed. So in the context of EDI system design too, it seems to be worthwhile to pose the questions: how were those EDI systems designed, why did they turn out to be successful or not successful and what constitutes successful in this context anyway?

Theory

The questions which have been raised have a highly practical orientation but can also be approached from a theoretical perspective. Nothing is quite so practical as a good theory (Van de Ven 1989). Further theoretical questions are: which theoretical perspectives are useful in order to learn how the design process can be understood, what can be learned from these theories, how do these theories explain successful or unsuccessful design and what do these theories explain about the possibilities of initiating, directing and controlling design activities?

In this study theoretical concepts from organization theory are used. It was decided to concentrate on two relevant schools of thought within organization theory. First the question was raised: can design be understood from a decision-making perspective? The school of thought dealing with this question is named the Decision-making school. The Decision-making school focuses on the assumption that individuals and organizations behave in a procedural rational fashion. Procedural rationality is the effectiveness, in light of human powers and limitations, of the procedures to choose actions (Simon 1978). From a procedural standpoint, our interest would lie not in the solution of the problem itself but in the method used to discover it or the process that generated it. A theory of procedural rationality is a theory of efficient procedures for finding good solutions. Simon (1979) distinguished three phases within the decision-making process: intelligence, design, choice. Design in this sense deals with the inventing, developing and analyzing possible courses of action.

Second the question was raised: can design be understood from the context in which it has taken place? The school of thought dealing with this question is called the Environmental school. In this school decision-making is expanded to management. Management can be defined as the initiation, direction and control of purposeful activities (Kampfraath and Marcelis 1981). In the Environmental school the focus is on the relationship between environment variables and appropriate management concepts and techniques that lead to effective goal attainment (Luthans 1976).

From those fundaments a theory was developed which can provide answers to the more practically-oriented questions outlined earlier. Theoretical and practical questions which are at the heart of the scientific speciality of Information Management. Theoretical concepts can be distinguished in terms of their descriptive or prescriptive nature. Descriptive concepts or models describe the reality as it is. Prescriptive concepts prescribe the reality as it should be. In the field of Information Management it would seem that prescriptive concepts are dominant, see for example Nielen (1969); Laagland (1983); and Roest (1988). It would seem that the relative youthfulness of this specialism caused this prescriptive orientation. The problems stated in this field stem from the fact that researchers too often focus on prescriptive models of which the foundations are not theoretically grounded. There is a lack of sound descriptive concepts in the design process of information systems. In this study a descriptive theory related to the design management of EDI systems will be developed.

This study has been motivated on practical and theoretical grounds. But let us be more precise. What is the specific problem this study addresses, what are the objectives or what new insights will the reader have gained by the end of this study?

1.2 Problem definition

This study has focused on three central questions. Those questions are:

- *What factors are responsible for the success or failure of the design of an EDI system?*
- *How are these factors related to the success or failure of the design of an EDI system?*
- *Why are these factors responsible for the success or failure of the design of an EDI system?*

In this study three objectives have been pursued. These objectives are:

- To investigate the design process of EDI systems from a practical and theoretical perspective;

- To develop a model to describe factors relevant to EDI system-design success;
- To investigate the proposed model empirically.

The model to be developed is called the Design Management Theory for EDI systems. In the field of Information Management little interest has been shown for descriptive models outlining the management of the design of EDI systems. The choice of the three objectives outlined above was motivated by a desire to contribute to the theory of EDI system design management.

The three central questions have been split up into more operational questions like:

- What are the characteristics of EDI systems and what is the development process involved?
- What can be learned from the Decision-making and Environmental school?
- What theoretical framework is falsifiable and what useful?
- How can this theoretical framework be tested?
- What are the results of the testing?
- What is the interpretation and explanation of these results?

These questions will be answered in the following chapters.

1.3 Outline and scope

This study follows the empirical cycle described by De Groot (1981). The cycle describes a scientifically responsible method of gaining and using knowledge and insights. The starting point for this study is the problem definition. The empirical cycle can be divided into phases. De Groot (1981:29) distinguishes five phases:

Phase 1: *Observation*. Collecting and grouping of empirical factual material and forming of hypotheses;
Phase 2: *Induction*. Formulation of hypotheses;
Phase 3: *Deduction*. Determination of special consequences from the hypotheses in the form of testable predictions;
Phase 4: *Testing*. Testing of the hypotheses with regard to the outcome of predictions on new empirical material;

Phase 5: *Evaluation*. Evaluation of the outcome of the testing in connection with the formulated hypotheses or theories and in connection with possible, new and corresponding research.

In this study the phases 1, 2 and 3 will be called the *'theory building'* part of the empirical cycle, phase 4 the *'theory testing'* part of the cycle and phase 5 the *'interpretation and perspective'* part. A description of the activities is given for each phase.

Theory building
In phase 1 of this research the design of EDI systems was reviewed with the help of literature research. Characteristics of EDI systems dealing with design and management were mapped out in theory and practice. Two schools of thought seemed to be relevant related to the problem stated: the Decision-making school and the Environmental school. In phase 2 constructs and variables, related to those schools of thought, were used to formulate the Design Management Theory for EDI systems. The Design Management Theory was formulated with hypotheses. In phase 3 the variables in the hypotheses were operationalized. Hypotheses were transformed into testable predictions.

Theory testing
In phase 4 hypotheses were tested. Theoretical concepts can only be proven valid when variables of the concept can be observed and measured. Therefore in this study great care has been taken in the selection of a research strategy. Which research approaches are useful, which research material is useful, how can the variables be measured? Researchers have debated at length about the strengths and weaknesses of used research methods and material in the specialized field of Information Management, see for example Cash and Lawrence (1989); Kraemer (1991); and Nissen et al. (1991). In general two approaches emerge from the debate: the quantitative approach and the qualitative approach. Usually the quantitative approach uses statistics to generalize its results. The qualitative approach focuses on the details of the research object in terms of its context and dynamics. In this study the choice of the research approach and material has been justified on the basis of the problem stated. Both alternatives have their strengths and weaknesses and they should be seen as complementary rather than mutually exclusive. Kaplan and Duchon (1988) and Weill and Olson (1989) suggest that in the field of information systems research, a wider selection of methodologies should be used and a combination of qualitative and quantitative measures in the same study. In this study it was decided to use both approaches, more specifically, the survey research

method with a survey using a questionnaire in a structured interview setting and multi-variate analysis methods on the one hand, and the case study with analytic induction on the other. The first test was quantitative in nature. Hypotheses were tested by using survey research. A questionnaire was composed and used based on the Design Management Theory. Special attention was given to the quality of the measuring instrument by testing its validity and reliability. Thirty-five EDI project managers from 35 different EDI projects were interviewed in a structured interview setting using this questionnaire. Data were analyzed by using multi-variate analysis methods. The results of the survey were analyzed and some new questions raised. The second test was of a qualitative nature. These new questions were studied in depth using the case study method. The case study on the EDI Flower project was concerned with the design process and the product of that process. Documents were analyzed and the project manager was interviewed.

Interpretation and perspective
In phase 5 the results were evaluated by interpretation and discussion.

Scope of the research
The scope of the research is subject to certain limitations. The following limitations have been imposed for the following reasons:

- The research is restricted to *EDI systems*; EDI systems are new phenomena in the specialized field of Information Management, little information is available on this issue. The interorganizational aspects of these systems make the development more difficult to manage and therefore more challenging to investigate.

- The research is restricted to decisions taken before and during the *design process* of EDI systems. No specific attention is paid to the building and implementation of these systems. In the literature some evidence is found for the thesis that the successful implementation and use of information systems is strongly affected by the decisions taken in the design process. For example Bots et al. (1990:563) argue that 64% of software faults in information systems are related to the design process of information systems. The rest, 36% of software faults, are related to the building and implementation process of information systems. It was assumed that those relations also exist in the development of EDI systems.

- The research is restricted to the design process of EDI systems in *projects*; No attention is paid to the design process of EDI systems in a non-project form. Measuring the success or failure of the design process and its product and judging relevant factors related to design management are more complicated and complex in those situations. In the Netherlands most design processes of EDI systems are carried out in the form of projects. They have been described by Ediforum, the National Dutch EDI organization, see Ediforum (1990); Ediforum (1991); and Ediforum (1992).

- Empirical research is restricted to *Dutch* EDI projects; cost and time factors led to the decision to investigate Dutch EDI projects running in economically relevant sectors in the Netherlands.

1.4 Structure of the book

The structure of the book follows that of the empirical cycle. The book is divided into three parts: theory building, theory testing, interpretation and perspective.

Theory building
In part I the theoretical framework is constructed. Part I consists of three chapters. In chapter 2 background information on EDI is provided and the design of EDI systems is considered in detail. Chapter 3 contains a description of the two relevant schools, for the problem stated, within organization theory: the Decision-making school and the Environmental school. Within the Decision-making school three perspectives are distinguished: the rational, the political and the garbage-can perspective. Within the Environmental school three perspectives are also distinguished: the contingency, the strategic choice, and the consistency perspective. In chapter 4 fundamental constructs and variables of those perspectives are integrated and used as foundation for a theoretical framework called the Design Management Theory. The theory is presented in the form of testable hypotheses.

Theory testing
In part II the theoretical framework is tested corresponding with phase 4 of the empirical cycle. Part II consists of three chapters. In chapter 5 the research approach and research material related to a quantitative test are described. It is argued that a survey of EDI project managers in a structured interview setting is appropriate. In chapter 6 the data

of the survey are presented. Specific questions have arisen from the results of the survey. These have served as the starting point for a case study. A justification for the use of a case study for this purpose is given. In chapter 7 the research approach and research material related to a qualitative investigation and the results of the EDI Flower project are presented.

Interpretation and perspective
In part III the interpretation of the empirical results takes place. Part III consists of two chapters. In chapter 8 the results of the survey and the case study are interpreted and discussed. A revised Design Management Theory is presented. In chapter 9 summary and conclusions are presented and suggestions for further research are outlined.

1.5 Summary

- Electronic Data Interchange (EDI) deals with the electronic interchange of structured and normative data between computers of transactions-related organizations. For organizations in the 1990s, the design of EDI systems will be of importance accomplishing effectivity and efficiency objectives. The designing of EDI systems is a fascinating but little understood activity.

  This study will focus on the factors responsible for the success or failure of the design of an EDI system. Three questions are central is this study:

  - What factors are responsible for the success or failure of the design of an EDI system?
  - How are these factors related to the success or failure of the design of an EDI system?
  - Why are these factors responsible for the success or failure of the design of an EDI system?

  In this study three objectives are pursued. These objectives are:

  - To investigate the design process of EDI systems from a practical and theoretical perspective;
  - To develop a model to describe factors relevant to EDI system-design success;

- To investigate the proposed model empirically.

Two theoretical questions have been investigated. The first question is: Can design be understood from a decision-making perspective? The second question is: Can we understand design from the context in which it has taken place? Answering these questions involves an investigation of two schools of thought: the Decision-making school and the Environmental school. These schools may provide theoretical answers to these theoretical questions. The answers will form the foundation for a Design Management Theory to be developed in this study.

PART I THEORY BUILDING

'Everyone designs who devises courses of action aimed at changing existing situations into preferred ones.'

- Herbert Simon, *The Sciences of the Artificial* -

'There is a good deal of superstition among designers as to the deathly effect of analysis on their intuitions - with the unfortunate result that very few designers have tried to understand the process of design analytically.'

- Christopher Alexander, *Notes on the Synthesis of Form* -

2 CHARACTERISTICS OF EDI SYSTEMS

2.1 Introduction

The main focus of the central questions is EDI system design. This chapter will focus on the characteristics of EDI systems and how they are designed in practice. The following questions will be raised:

- What are EDI systems and what are the characteristics of these systems?
- How can the quality of EDI systems be defined?
- What are the characteristics of the development of EDI systems?

In section 2.2 the definition of an EDI system will be looked at more closely. Reasons for installing EDI systems, domains and examples of EDI systems will be discussed. In section 2.3 the quality of EDI systems in terms of the quality of the product viz. the EDI system will be presented. In section 2.4 the development process of those systems will be investigated.

2.2 Definition of EDI systems

First EDI and EDI systems will be defined. Second, EDI will be compared with other forms of communication like fax, telex, and e-mail. Third, EDI systems will be described in terms of reasons for installation and domains.

EDI systems

As described in the previous chapter EDI is defined as:

> *The electronic interchange of structured and normative data between computers of transactions-related organizations.*

The definition can be further clarified by analyzing some discussions related to aspects of EDI, such as:

- *Interchange between computers.* The automatic generation, communication and processing of data between computers is the key function of EDI. To be more precise, it is better to define it as the interchange between application systems, because if organizations do not integrate EDI in their internal application system, then they are not making optimal use of it. There is some discussion as to whether EDI is the interchange of electronic data or the electronic interchange of data. Those who adhere to the first definition consider the exchange of floppy discs to be a form of EDI. Those who adhere to the second definition would reject this as a form of EDI. The second definition is chosen in this study.

- *Transactions-related organizations.* The first discussion on this part of the definition centres around the definition of organization. One school of thought sees the electronic interchange of data between two branches of one organization as a form of EDI. Their opponents say this is not a form of EDI because there is an interchange between legally independent organizations. This study adheres to the first school of thought. The characteristics of EDI are not exclusively related to the independency of two organizations. In other words, the electronic interchange within a single organization is also EDI. However, this study concentrates on the design of EDI systems between two or more independent organizations.
  The second discussion on this part of the definition concerns conflicting views on the meaning of transaction-related. In the first version, only commercial transactions are a form of EDI. In the second version, non-commercial transactions (like Computer Aided Design data) are also a form of EDI. This study opts for the second version.

An EDI system can be defined as:

> *A business facility for the electronic exchange of structured and normative data between computers of transaction-related organizations.*

Instead of paper documents linking the organizations, electronic equivalents of the documents would be transmitted. This substitution requires efforts in three broad areas (Konsynski 1992). First, each organization must replace the manual interpretation of incoming documents with computer software. Second, the two (or more) organizations must replace the functions of the postal service with an agreement on a telecommunications link. Finally, the organizations must establish the terms and conditions governing electronically-placed orders and agree on the operational details of an electronic link (Konsynski 1992). An EDI system provides information for business functions. These business functions are performed by users with the help of the information provided by the EDI system. In the EDI system the two following components seem to be relevant: the application system and the communication system. The application system of organization A provides an in-house file. The communication system converts the in-house-file into an EDI message which is communicated through a communication network and reconverted to the in-house file of the receiving application system of organization B.

EDI systems could be seen as a species of interorganizational systems. Interorganizational systems (IOS) are defined as:

> *Information systems that are jointly developed, operated and/or used by two or more organizations that have no joint executive (Wierda 1991).*

Groenenboom (1992) identifies four forms of interorganizational information systems:

1. An IOS with message coupling. The IOS is an instrument for message exchange between organizations. Electronic post and EDI systems with post box communication are examples of this form.
2. An IOS with access to databases. Not only message exchange but also access to databases is provided. One example is videotex systems.
3. An IOS with access to application systems. Not only databases but also the application systems themselves are usable by both partners.
4. An integrated IOS. It is a completely integrated system suitable for common use by the partners in the developed information system.

Other forms of data exchange

There are other ways of exchanging data in the form of documents between organizations. The following ways can be distinguished, see also table 2.1:

. *Manually-prepared messages*. These messages are prepared on paper by typewriter or dataprocessor. The message is delivered by post to the other organization.

. *Automatically-prepared messages*. The message is automatically prepared on paper by the sending organization. The receiving organization might read and interpret the received data on the message.

. *Fax- and telex messages*. Messages are manually or automatically prepared and are distributed to the receiving organization by fax- or telex machine.

. *Electronic mail messages*. With electronic mail it is possible to send messages from one PC to another, so that the message can be read on screen.

. *Videotex messages*. With the help of a PC or terminal a connection can be made with the computer of another organization. Data can be obtained from or sent to the databases of this computer.

Table 2.1: methods of data exchange and their characteristics (Van der Vlist et al. 1991:27).

data exchange	automatic exchange	electronic exchange	structured/ normative	between computers of different organizations
. manually-prepared messages	no	no	yes/no	no
. automatically-prepared messages	no	no	yes/no	no
. fax- and telex messages	yes/no	yes	yes/no	no
. electronic mail messages	yes/no	yes	no	no
. videotex messages	no	yes	yes	no
. electronically-readable messages	no	no	yes	yes
. EDI messages	yes	yes	yes	yes
. PDI messages	yes	yes	yes	yes

. *Electronically-readable messages*. Messages are distributed by an electronically readable information carrier, like a tape or floppy disc. The preparation and processing of the data is done by computers. The carrier is sent to the receiving organization.

. *EDI messages*. The application program in the EDI system prepares an EDI message automatically. The message is exchanged automatically and electronically. The message is structured and normative. The receiving computer recognizes the content and form of the EDI message and processes it automatically.

- *PDI messages*. Product Data Interchange (PDI) messages are messages in which the content of the message deals with the specification of products.

In the near future, some global network services will provide EDIPOST and EDIFAX. EDIPOST will enable EDI messages - which are undeliverable by electronic means - to be printed out and dispatched by the postal system. EDIFAX will offer an alternative fax route to EDI messages which cannot be delivered by normal interchange means. In this study only the exchange of EDI messages will be investigated.

Reasons for installing EDI systems

From the literature and the practice several reasons for installing EDI systems can be distinguished, see Johnston and Vitale (1988); and Rockart and Short (1989). Two streams can be categorized. The first stream deals with strategic/effectiveness objectives, the second stream deals with efficiency objectives. The strategic/effectiveness objectives are:

- *Providing existing products for new markets*. It is argued that EDI systems can reduce lead time which facilitates the selling of products in (geographically) new markets.
- *Providing new products*. It is reported that organizations can offer new products or services (for example databases) of which EDI systems are an important element. For example, Venkatraman and Kambil (1991) reported new services related to tax-return filing.

The efficiency objectives are:

- *Improving the quality of interorganizational communications*. Stern and Kaufmann (1985) identified three ways to improve the quality of the interorganizational communication by using EDI systems: (1) faster transmission, (2) greater accuracy, an (3) more complete information about the transactions.
- *Reduction of administration costs*. It is argued that EDI systems produce less paper resulting in less paperwork and fewer paper costs, also fewer faults in data processing and data distribution are reported. For example EDP Analyzer (1987) describes an American study which reports a fault reduction by 30% in the sending of invoice messages.
- *Reduction total inventory-management costs*. Anvari (1992) paid attention to the impact of EDI on the reduction of the total inventory-management costs. He

concluded that the reduction in the level of inventories constitutes a major benefit of EDI systems. It reduces lead time, it reduces uncertainty during lead time and it reduces ordering costs.

Domains of EDI systems

Lyytinen and Hirschheim (1987) distinguish the four domains of an information system (IS): as the technical domain, data domain, user domain and organizational domain. Bots et al. (1990:25) distinguish a fifth domain in an IS: the software domain. These domains could also be distinguished in an EDI system. In an IS and EDI system these domains interact and are subject to constant change. In general, automatization replaces the user and organizational domain by the technical and software domain (Bots et al. 1990:124). These five EDI system domains will be discussed in detail.

. *Technical domain.* The technical domain deals with the technical infrastructure of the EDI system. The technical infrastructure deals with the internal and the external technical infrastructure. The internal technical infrastructure deals with the internal hardware of the applications and the internal telecommunication infrastructure. The external technical infrastructure deals with the hardware and telecommunication of the external network. The external technical infrastructure (in the Netherlands) may be the telephone network (circuit switching) or Datanet 1 (packet switching) or a Value Added Network (VAN) (message handling).

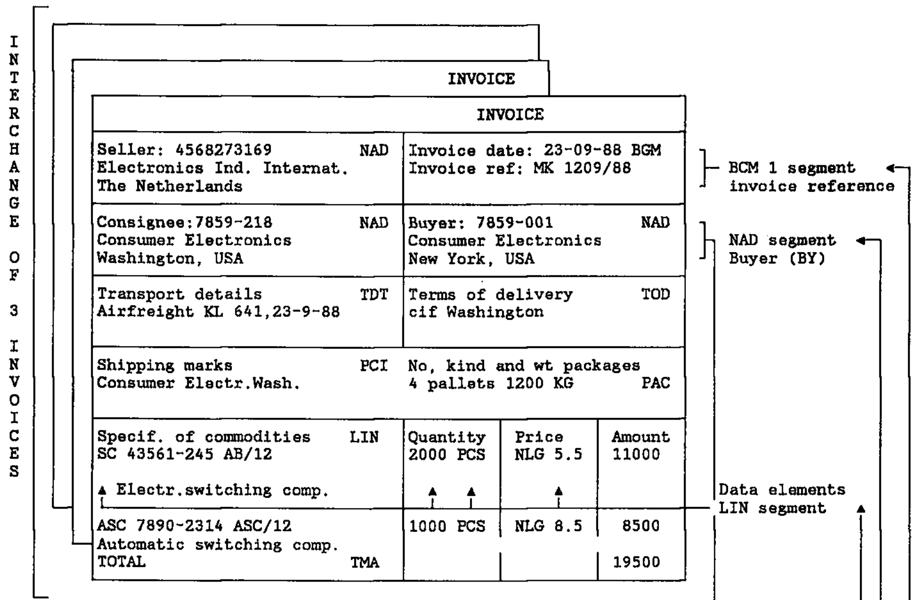
. *Software domain.* The software domain deals with the software for the electronic interchange of data and the software of the applications. An overview of EDI software providers and costs and features of EDI software packages in the United States for 1989 is given in Eyler (1989). In the Netherlands a survey for 1991 is described by Ediforum (1991).

. *Data domain.* The data domain deals with the nature, form and content of the data processed by, and communicated in the EDI system. As discussed before, EDI deals with structured and normative data. Information can be defined as data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or prospective decisions (Davis and Olson 1984). Three aspects of information are important: syntax (rules), semantics (meaning) and pragmatics (effect, result) (Bots et al. 1990:118). In EDI systems structured and normative data are exchanged between computers. Standardization is one of the basic conditions. An international standardization has been developed named

EDIFACT (Electronic Data Interchange For Administration, Commerce and Transport). EDIFACT embodies international rules, recommendations, norms and data definitions. These are published in the United Nations Trade Data Interchange Directory (UNTDID). In figure 2.1 a paper invoice with an equivalent EDI invoice message is shown. In the upper part of figure 2.1 the interchange of three invoices is presented. In the third invoice data are obtained related to, for example seller, invoice date, consignee etcetera. In the lower part of figure 2.1 the equivalent EDI invoice message is presented. An EDI message is divided into segments. Mostly coded identifiers are used in EDI messages e.g. identification of seller/buyer. Air freight, for example, is indicated by the value '40' in segment TDT.

Kubicek (1992) concentrates on the question of whether data exchange formats like e.g. EDIFACT define syntax, semantics and pragmatics for the automatic processing of business documents. His answer is that EDIFACT does *not* give these definitions. EDIFACT deals with the syntax and not with the semantics and pragmatics of datacommunication. EDIFACT defines the *syntax* of message types i.e. the sequence, length and data type of the segments of a message. *Semantics* refer to the meaning of the characters in these data fields. In a few cases (for example price) they can only be understood by a further qualifier (for example currency). A common key covering the supplier, customer and article has to be agreed on, and for the quantity, a packing unit has to be determined. *Pragmatics* is to be understood as the expected activities at the receiving end, triggered by the message and likely reactions. The functionality of the application programmes have to be determined in the light of these action-reaction patterns (Kubicek 1992). The second problem relates to the criteria for mapping the locally-agreed definitions of entity types and attribute types with, for example, the EDIFACT segments and datafields. At this moment this mapping process is done more or less randomly. No objective criteria occur to consistently map the locally-defined data to the internationally-defined data.

User domain. The user domain identifies the skills, competence, personal traits, and motivational factors of the user population that is directly or indirectly involved with the system. The user performs specified business or organizational functions. The fact that EDI deals with the exchange between computers means there are no (direct) users in the exchange process. The (end)users can be identified as the users of the application systems in the organizations participating. Application systems receive from and send data to the communication system. The users get data from these application systems.



Syntax delimiters	UNA:+.?'
Interchange header	UNB+UNOA:1+501234:14+586421:91+881023+CE145'
Message header	UNH+1025+INVOIC:88:1'
Message ref.	BGM+380+MK1209/88+88102'
Seller ident.	NAD+SE+4568273169'
Seller ref.	RFF+CT+EII/88-4561'
Consignee ident.	NAD+CN+7859-218'
Purchase order ref.	RFF+PO+CE4539/HP659/003'
Buyer ident.	NAD+BY+7859-001'
Contract ref.	RFF+CR+IMP-1489/374/032'
Invoice currency	CUX+NLG:IN'
Payment terms	PAT+01+++05:03:1:60++++PAYMENT 60 DAYS FROM INVOICE DATE'
Transp. details	TDT++40+KL 641,23-09-88'
Terms of delivery	TOD+++CIF WASHINGTON'
Package details	PAC+4++:PALLETS'
Package weight	MEA+PD+04+KG:1200'
Markings	PCI++CONSUMER ELECTR.WASH.'
Detail delim.	UNS+D'
Article line details	LIN+++SC 43561245AB/12:SA++21:2000:PCS+5.5:CT:1'
Article line details	LIN+++ASC7890-2314ASC/12:SA++21:1000:PCS+8.5:CT:1'
Summary delimiter	UNS+S'
Total invoice	TMA+19500'
Message control	UNT+21+1025'
Second message	....
Third message	....
Interchange control	UNZ+3+CE145'

Figure 2.1:paper invoice with equivalent EDI invoice message (Derived from Commission of the European Communities 1989:55).

- *Organizational domain.* The organizational domain captures the nature and content of organizational roles by which organizational activities and tasks are carried out. The users have to follow procedures to fulfil the organizational roles. Some of the procedures deal with the interaction with the EDI system.

Examples of EDI systems

In this section some examples of EDI systems will be presented. The first example is taken from the financial sector. The second example deals with an EDI system in the agribusiness. The third example is taken from the transport sector. The fourth example of an EDI system deals with the production of trucks.

- Example Royal Bank of Scotland

  The Royal Bank of Scotland has processed its first EDI trade payment in which both payment and associated remittance details are passed electronically from customer to supplier via the bank. The bank's EDI Trade Payments system is currently being used on a pilot basis and is a truly paperless system (Electronic Trader 1991a).

- Example AVEBE

  The major Dutch starch producer AVEBE has implemented a new worldwide EDI solution in order to facilitate direct and indirect links with it trading partners. AVEBE exports over 700,000 tonnes of goods to over 100 countries. Its orders vary in size, and are handled in a number of different languages, factors which complicate logistics considerably. The company's old system relied on a number of leased lines between sales offices which were using different systems. One of the problems was the cost of communication, which was determined by the cost of the leased lines. Other disadvantages were that it used a central automation concept, and that it was not very suitable for dealing with external trading partners. The company therefore decided to go for the development of a corporate EDI network. AVEBE decided to move away from a specific network type solution. Instead it elected to use an ODEX/OFTP solution, provided by Data Interchange, and the X.25 packet-switched network was chosen as the main communications medium. As a result the system, named Starchnet, uses the same infrastructure to provide direct communications with certain of its trading partners, notably the hauliers, and indirect communications with trading partners already using a VAN.

Indirect communications are also applied to the international sales office in Europe, the Far East and USA (Electronic Trader 1991b).

. Example SEALAND
SEALAND is a worldwide transportation and logistical organization. It provides a worldwide network of proprietary terminals, warehouses and intermodel connections. These facilities enable them to load more cargo, in more places, more rapidly and deliver a broader and more innovative array of transportation and logistics services 'door-to-door'. EDI systems offer a sophisticated yet flexible, tailored service. One of the EDI systems is named Sea-Lect™. It is for booking, tracking and managing the shipment of perishable commodities. It links customers, electronically, in any location directly to the Sea-Land mainframe. Customers can check routes, sailing schedules, connection services, tariffs and book cargo electronically. Customers can track cargo and get immediate answers about booking status, freight bills, manifests, and customs clearance. Customers can access a special commodities database for planning and logistics information.

. Example DAF
DAF produce trucks and use EDI with 40 of their 900 suppliers. One of these suppliers provides truck seats. The following messages are exchanged between DAF and the supplier. Some weeks before the planned supply a prognoses is given of the number of seats required. Some days before the planned supply the exact number of seats plus the specification is given. One day before the planned delivery DAF informs the supplier which seat has to be delivered when and where. The last piece of information is particularly critical in terms of time. DAF uses EDI to lower the average costs of inventories and to reduce the average lead time.

2.3 Quality of EDI systems

In the world of information systems (IS) more attention is now being paid to the quality of those systems. The focus is now on the quality of the product viz. the IS and to the quality of the process viz. the development process of the IS. In this section the quality of an EDI system in terms of product quality will be determined. Steenkamp (1989) identifies four major approaches to product quality:

- The *metaphysical* approach. The metaphysical approach concentrates on the essence of quality. Quality is synonomous with innate excellence. Basically, it is an unanalyzable property that an individual can learn to recognize only through experience. People differ about quality not because quality is different but because people are different in terms of experience.
- The *production management* approach. This approach regards quality as a concept that is objectively measurable. Quality is described in technical specifications. Quality is conformity with these technical specifications.
- The *economic* approach. This approach studies the role of product quality in the market. Quality is in this approach, as in the product management approach, an objective property inherent in the product.
- The *perceived quality* approach. The perceived quality differs from the other approaches in that it regards quality neither as obsolete nor as objective. Quality is a subjective concept, dependent on the perceptions, needs, and goals of the individual consumer.

This study focuses on the *production management* approach and the *perceived quality* approach with respect to information systems as a product. In the production management approach the better the product conforms to its prescribed specifications, the better the quality. Product quality is achieved and maintained by four basically interrelated quality-determining parameters: quality of design, quality of production, continuity of service, and customer service after sale (Steenkamp 1989:11). This study focuses on the quality of design. Basically, quality of design refers to the determination of the quality standard the product must meet. Another term for quality of design is the well-known 'degree of excellence'. Quality of design pertains to three activities (Juran 1974):

1. Identification of what the consumer means by quality and identification of the consumer's quality needs;
2. Development of a product concept that meets these quality needs;
3. Translation of this concept into a detailed set of specifications which, if the product fulfils these specifications, will meet the consumer's needs.

An important tool in achieving quality of design is reliability engineering. It involves (1) constructing designs from their basic parts, (2) determining the failure probabilities for each system or subsystem, and (3) trying to strengthen the weak links in the chain by product redesign or by incorporating more reliable components (Garvin 1983).

In the perceived quality approach, perceived quality is simply measured in terms of 'fitness for use' or some variant thereof. It is generally recognized that consumers' perceptions of quality are based on one or more cues. A cue is defined as any informational stimulus about or relating to the product. Steenkamp and van Trijp (1988) tried to integrate the production management and perceived quality approach by:

- Identification of quality criteria of consumers in the target market;
- Translation of these consumer criteria in technical product specifications;
- Establishing methods of production and quality control in order to meet technical product specifications.

Their methodology is helpful to link quality perception to objective product standards. Quality perception research can act as research guidance for consumer-oriented product development. In other more adult fields, what quality constraints look like is clear, but in the field of information systems it is still difficult to formulate these quality constraints. One of the first reseachers in that field was Boehm (1978), who focused on software quality in general. The adapted version of Boehm's quality tree is presented in Bots et al. (1990:545). Quality is refined into the cues usability, maintainability and portability. Hofstede (1992) argued that the quality of an information system, in his case a Decision Support System, can be meaningfully assessed. Groenenboom and Van Putten (1989) argue that by specifying the quality attributes one has to focus on the problems of the user. One of the few studies to explicitly focus on the user is that of Delen and Rijsenbrij (1990a and 1990b). They distinguish dynamic quality attributes and static quality attributes of an IS related to respectively users, and developers and administrators. This study used these quality attributes and translated them into quality attributes of an EDI system. In figure 2.2 the quality attributes of an EDI system are presented. The dynamic quality of an EDI system can be refined into the reliability, the continuity, the efficiency and the effectivity of the EDI system. Reliability deals with the certainty that the data are exchanged in a correct, complete and permissable way within the given time constraints. Continuity deals with the certainty that data exchange will take place, even if there were to be a serious interruption. Efficiency deals with the ease with which the EDI system provides the information. Effectivity deals with the way in which the information provision contributes to the business objectives as specified in the information policy. These attributes are relevant for the user(s) of the EDI system. The static quality attributes are refined in flexibility, maintainability, testability, portability, connectivity, re-usability and suitability of the infrastructure. These static quality attributes are relevant for the developers and administrators of the EDI system. Those quality attributes have to be specified in the EDI system design.

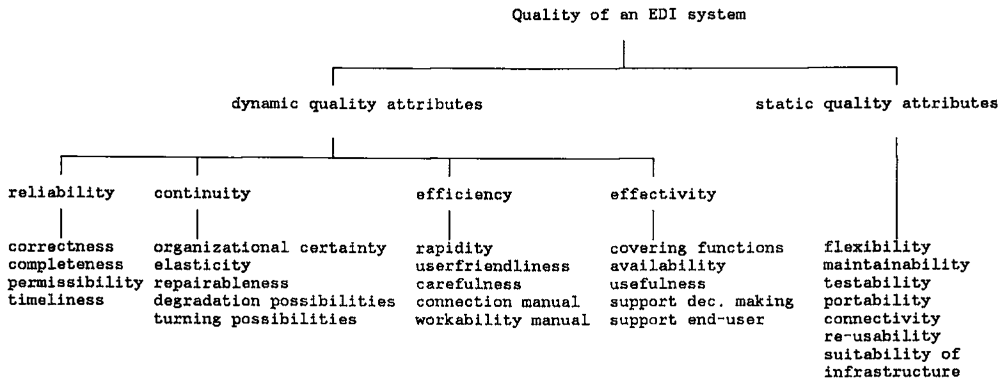


Figure 2.2: quality attributes of an EDI system, derived from Delen and Rijsenbrij (1990a and 1990b).

2.4 Development of EDI systems

In this section a closer look at the development of EDI systems will be taken. The question is: how are EDI systems developed in practice. The development of EDI systems is rather new. In the literature there is no consensus about how to develop those systems. In order to have an idea about the development steps executed in practice, the development methods used by consultancy organizations in the Netherlands were investigated. In Ediforum (1990) twenty nine (!) of these development methods are listed in the form of stepwise plans. These methods are presented by the consultancy organization which developed and used the development method. Within the group of consultancy organizations three groups could be distinguished. The first group has a hardware background (for example Bull, Digital, Nixdorf), the second group has a software background (for example Cap Gemini Pandata, CSD, Volmac), the third group has an organization consultancy background (for example Bakkenist, Berenschot, Coopers & Lybrand, KPMG Klynveld Bosboom Hegener). The following general characteristics of these EDI system development methods could be distinguished:

- Most development methods are project-oriented;
- Most development methods distinguish steps and products;.

- Most developing methods follow the Information System Development Life Cycle (ISDLC);
- Most development methods focus on the strategic aspects of introducing EDI in organizations;
- Most development methods advise starting with a pilot project, evaluating it and eventually starting up a broader project;

In general the following steps could be distinguished in the development methods. For each of the steps the important activities are described:

1. *Orientation*. In the orientation process organizations look at what EDI has to offer. They execute an external and internal analysis. In the internal analysis they ask what (new) organizational objectives can effectively be reached by using EDI and what (new) organizational objectives can be efficiently achieved by using EDI. The product of the orientation process is a proposal for a pilot project. In the proposal objectives, possible partners, possible application areas, resources, global planning, project organization and expected end-products have to be specified.

2. *Preparation Pilot project*. In the preparation process attention is focused towards the selection of the project manager, the members of the project organization, and the management of the development process. Attention has to be given to a further specification of the selected application areas. Also the organizations participating have to be selected. The preparation process results in a pilot project plan. This plan serves three functions. For the project group it is a guide for the management of the project. For the participating organizations it represents a commitment by their top management to provide essential resources to the project. Thirdly, the document shows how the coordination and cooperation between the participating organizations has been specified.

3. *Pilot Project*. In the pilot project process five sub-processes can be distinguished: defining the EDI system, designing and building the EDI system, implementing the EDI system, using and maintaining the EDI system, and evaluating the pilot project. In the definition phase the demand represented in the form of a program of requirements is set up. The supply is investigated as well, this is done by analyzing the possibilities of standard EDI messages, EDI software and EDI-related hardware. The different network providers have to be investigated too. The supply and demand have to be attuned. In the design and building phase the functional and

technical requirements are specified to such an extent that it then becomes possible to write the required computer programs and build the technical architecture. Also the organization around the EDI system (procedures) has to be specified. Once built, the EDI system has to be tested. In the implementation phase the EDI system is first implemented and then used and maintained. In the evaluation phase one has to consider whether the objectives of the pilot project were actually met and whether it is feasible to broaden the application of EDI towards new areas or new organizations.

4. *Preparation Broadening project*. In this preparation process attention must be paid to the specification of these new application areas, the selection of new organizations willing to participate, and a new plan for the project organization. The preparation process results in a specified broadening project plan.

5. *Broadening project*. The broadening project can be divided into five phases: define the EDI system, design and build the EDI system, implement the EDI system, use and maintain the EDI system, and evaluate the broadening project.

2.5 Summary

The following questions were answered in this chapter:

. What are EDI systems and what are the characteristics of these systems?

- Definitions and characteristics of EDI systems were investigated. An EDI system can be defined as a business facility for the exchange of structured and normative data between computers of transaction-related organizations. Five relevant domains of an EDI system can be distinguished: the technical domain, software domain, data domain, user domain and organizational domain. In an EDI system these domains interact and are subject to constant change. Automatization in general replaces the user and organizational domain by the technical and software domain.

. How can the quality of EDI systems be defined?

- The quality of EDI systems seems to be of increasing importance. Two approaches seems to be relevant: the production management approach and the perceived quality approach. The first approach defines quality as conformance to technical specifications. The second approach defines (perceived) quality as 'fitness for use'. This study linked the two approaches. Dynamic and static quality attributes of EDI systems are distinguished which are relevant in the design process of those systems for respectively users, and developers and administrators.

. What are the characteristics of the development of EDI systems?

- Characteristics of the development of EDI systems are derived from the development methods used in practice. Different development methods are used to develop EDI systems. Important characteristics of those development methods are that they are project-oriented, follow the information system development life-cycle, distinguish processes and products, pay attention to strategic aspects of EDI, and start with the definition of pilot projects.

3 THEORIES ON DECISION-MAKING AND ENVIRONMENT

3.1 Introduction

In the previous chapter the design of EDI systems was investigated from a practical point of view. In this chapter the problem will be investigated from a theoretical point of view. Two theoretical questions will be raised. The first question is: Can design be understood from a decision-making perspective? The second question is: Can we understand design from the context in which it has taken place? This study will elaborate on two relevant schools of thought: the Decision-making school and the Environmental school. The first school views organizational problems in general, and more specifically the designing of systems, as a decision-making process. Within this school of thought three different perspectives will be discussed. Herbert Simon, the 1978 Nobel Prize laureate in Economics, has provided numerous insights into this school of thought. Most of his papers and essays are contained in the two volumes entitled '*Models of Bounded Rationality*' (Simon 1982). The second school of thought elaborates on management and the relationship between management and environment. Its main proposition is that there is no one best way to organize and not all methods of organizing are equally effective. Appropriate management concepts and techniques that lead to effective goal attainment have to be chosen with regard to relevant environmental variables. In this chapter two questions are discussed:

- How can the design process of EDI systems be understood as seen through the eyes of adherents to the Decision-making school?
- How can the design process of EDI systems be understood as seen through the eyes of adherents to the Environmental school?

In section 3.2 the Decision-making school and its three perspectives will be presented. In section 3.3 the lessons learned from this school of thought will be discussed. In section 3.4 the Environmental school and its three perspectives will be presented. The lessons learned from this school will be discussed in section 3.5.

3.2 The Decision-making school

Three different perspectives will be discussed within the Decision-making school: the *rational* perspective, the *political* perspective, and the *garbage-can* perspective. Batelaan (1991) distinguished these three perspectives or models but also argued that these three perspectives are complementary in the sense that they explain different aspects of how decisions are actually arrived at.

The rational perspective

Rationality denotes a style of behaviour that is appropriate to the achievement of given goals, within the limits imposed by given conditions and constraints (Simon 1964). The goal may be assumed to take the form of maximizing the expected value of a utility function over some time interval. Further, the existence of the utility function may be derived from postulates about the ordering and consistency of the choosing organism's preferences. If a distinction is wanted between this very strict species of rationality and more general forms, the former may be termed optimality, the latter adaptiveness or functionality. The goal may be assumed to consist of criteria to be satisfied in an all-or-none way. It is important to make the distinction between those theories that locate all the conditions and constraints in the environment, outside the rational actor, and other theories that argue that constraints arise from the limitations of the actor himself as information processor. The first case is known as objective rationality, the second one as subjective or bounded rationality. The goals referred to in the definition may be goals of the choosing organism, goals of the social system to which he belongs, or goals imputed by the observer. An unambiguous use of the term rationality requires the user to specify what assumptions he is making about both goals and conditions.

Simon (1978) argued that a theory of rational behaviour must be quite as much concerned with the characteristics of the rational actors - the means they use to cope with uncertainty and cognitive complexity - as with the characteristics of the objective environment in which they make their decisions. In such a world, we must give an account not only of substantive rationality - the extent to which appropriate courses of action were chosen - but also procedural rationality - the effectiveness, in the light of human cognitive powers and limitations, of the procedures involved in choosing actions. Behaviour is substantively rational when it is appropriate to the achievement of given goals within the limits imposed by given conditions and constraints (Simon 1976). It should be noted that in this definition the rationality of behaviour depends upon the actor in only one single respect - his goals. Given these goals, the rational behaviour is determined entirely by the characteristics of the environment in which it takes place. Behaviour is procedurally rational when it is the outcome of appropriate deliberation (Simon 1976). Its procedural rationality depends on the process that generated it. From a procedural standpoint, the interest would lie not in the problem solution but in the method used to discover it. It should also be noted that a theory of rationality for problems is not a theory of best solutions - of substantive rationality - but a theory of efficient procedures for finding good solutions - a theory of procedural rationality.

Rational choice involves two kinds of guesses: guesses about future consequences of current actions and guesses about future preferences for those consequences. Men try to imagine what will happen in the future as a result of their actions and they try to imagine how they should evaluate what will happen. Theories of choice under uncertain conditions emphasize the complications involved in guessing future consequences. Theories of choice under conflict or ambiguity emphasize the complications of guessing future preferences (March 1986).

Simon published two papers that became a basis for the theory of choice. The first paper (Simon 1955) examined the informational and computational limits on rationality imposed by human beings. It suggested a focus on stepfunction utility functions and a process of information gathering that began with a desired outcome and worked back to a set of antecedent actions sufficient to produce it. The second paper (Simon 1956) explored the consequences of simple pay-off functions and search rules in an uncertain environment.

In the rational perspective, the decision-making process is conceived of as linear and orderly and is often described by using distinct phases or stages. Simon (1979) distinguished three phases within the decision-making process. The first phase, called *intelligence*, deals with searching the environment for conditions calling for decisions. Raw data are obtained, processed, and examined for clues that may identify problems. The second phase, called *design*, deals with the inventing, developing, and analyzing of possible courses of action. This involves processes to aid understanding of the problem, to generate solutions, and to test solutions for feasibility. The third phase, called *choice*, deals with selecting the particular course of action from those available.

People try to make decisions in a functional rational way but they are restricted by two - to some extent overlapping - concepts. These are bounded rationality and incrementalism. These are two concepts that give some valuable comment on the rational perspective of decision-making.

Bounded rationality

The concept of bounded rationality refers to the cognitive limits of human beings. 'Objective' social reality is too complex to be handled in all its complexities, so people develop their own constructions of reality. These constructions or models enable human beings to reduce complexity and to transform social reality into something that can be dealt with in decision-making processes (March and Simon 1958:152). As a result of people's limited information-processing capacities, it becomes very difficult to find optimal alternatives. In the bounded rationality paradigm actors are limited by the information-processing capacity of human beings. Actors do not:

- Have a complete set of information on the alternatives open to them and the consequences of these alternatives;
- Oversee the future consequences of all the alternatives if they have no experience with those alternatives;
- Consider all the consequences.

Disjointed incrementalism

Lindblom (1980) criticized the view that decision-making processes and policy-making processes can be approached from a perspective in which it is presumed that processes are to be structured into several stages or phases. He argued that:

> '*The step-by-step approach also risks falling into an assumption that policy making proceeds through a relatively orderly, rationalistic process. That policy making proceeds in this manner should be questioned rather than assumed*' (Lindblom 1980:4).

He viewed organizational decision-making as an incremental process of *'muddling through'* (Lindblom 1959). The search for solutions is incremental which means that it is focused on the area near the old solution. Lindblom argued in his later work that policy makers do not face a given problem, but instead they must identify and formulate their problem. He pointed out that political interaction and political controversy are important concepts for understanding the decision-making process. Lindblom developed a theory in which the rational perspective is adjusted for cognitive limits and political considerations. He developed a strategy of disjointed incrementalism which has three fundamental limitations compared with the rational ideal. These three limitations are:

- Decisions are conceived as a result of *margin-dependent choices*, which means that the search activities are focused on incremental changes in the actual situation;
- From the infinite number of incremental options only a *restricted variety of policy alternatives* is actually considered;
- For each alternative only a *restricted number of consequences* is evaluated.

Lindblom advocates that objectives are adjusted to means in the sense that what we establish as policy objectives we derive for a large part from an inspection of our means (Braybrooke and Lindblom 1963:93). Processes of policy formulation and goal-setting interact and these processes can be characterized by a reconstructive treatment of data. Original problem definitions and value systems may be changed as a result of new information. Analysis and evaluation are serial, remedial-oriented and socially fragmented (Braybrooke and Lindblom 1963).

Logical incrementalism

Quinn (1980:51) went further than just focusing on the 'cognitive limits' of people. He points out that the 'process limits' are of equal importance, that is the timing and sequencing imperatives necessary to create awareness, build comfort levels, develop consensus, and select and train people - that constrain the system yet ultimately determine the decision itself. Quinn (1980) demonstrates that most managers in large companies follow a logical incremental process in strategic decision-making. Managers purposely guided important actions incrementally toward strategies embodying many of the structural principles of elegant formal strategies (Quinn 1982). The process is rarely completely orderly, rationally predictable, or consistent. Instead it responds flexibly and opportunisticly to new threats, crises, and proposals, which could not have been foreseen at the time initial stimuli appeared to suggest the need for strategic changes (Quinn 1980:91). It seems to be that managers *'muddle with a purpose'*. They take a much more proactive approach towards change than suggested by Braybrooke and Lindblom (1963). Quinn (1980:104) outlines typical processes in logical incrementalism, like sensing needs, amplifying understanding, building awareness, creating credibility, legitimizing viewpoints, generating partial solutions, broadening support, identifying zones of opposition and indifference, changing perceived risks, structuring needed flexibilities, putting forward trail concepts, creating pockets of commitment, eliminating undesired options, crystallizing focus and consensus, managing coalitions, and formalizing agreed-upon commitments. The essence of managing incrementalism lies in these sequential consensus-building processes, these can be assisted, calibrated, focused and even stimulated by more formal strategic analysis and control techniques (Quinn 1980:146). These formal planning techniques are just a building block. In a later article Quinn (1985) focused on logical incrementalism and innovation in which the same principles appeared.

Rational perspective and IS design

Simon (1972) elaborated on bounded rationality and design. He took the game of chess as a microcosm that mirrors interesting properties of decision-making situations in the real world. He pointed out that:

> *'The engineering activities usually called 'design' have not been much discussed under the heading of rational decision-making. The reason for this should be clear from the foregoing discussion: classical decision theory has been concerned with choice among given alternatives; design is concerned with the discovery and elaboration of alternatives. Our exploration of the microcosm of chess has indicated, however, how the theory of design can be assimilated to a satisfying theory of rational choice.'*

Simon (1972) argues that in a situation where a chess player is searching for a combination (a strategy), he will not ordinarily, enter into such a course of action unless he can see it through to the end - unless he can design, that is, a water-tight mating combination. The evaluations and comparisons that take place during the design process are not, in general, comparisons among complete designs. Evaluations take place, first of all, to guide the search - the elaboration of the design itself. They provide the basis for decisions as to whether the design should be elaborated upon in one direction rather than another. Complete designs, when they are finally arrived at, are not generally evaluated by comparing them with alternative designs, but by comparing them with standards defined by aspiration levels. Simon (1972) pointed out that in the design of complex objects the process has an even more involved search structure. Here, the early stages of the search take place in highly simplified spaces that abstract most of the detail from the real-world problem, leaving only its most important elements in summarized form. When a plan, a schematized and aggregated design, has been elaborated in the planning space, the detail of the problem can be reintroduced, and the plan used as a guide in the search for a complete design.

In a Dutch article *'Designing, process models and decision-making'* Bosman (1986) investigated the causes of failure with regard to the design process of information systems. He focused on the lack of adequate methods for the formulation of the pragmatic aspect of the design of information systems. Firstly, he discussed the relation between methods of research and design. He distinguished two types of theories (conceptual and empirical) and two approaches (descriptive and prescriptive). Those form four theory/approach combinations. Every combination can attribute to design in the following way, see figure 3.1.:

1. *Conceptual theory/prescriptive approach.* In general, conceptual prescriptive theories present a solution for a given problem in the form of an algorithm. These algorithms can be used by the designer. Arrow *a* indicates the relation between those theories and design.
2. *Conceptual theory/descriptive approach.* Bosman distinguished conceptual descriptive theories which can be translated into empirical models (2a) and those which can not be translated into empirical models (2b). There might be a relation between these theories and design but they are not represented in figure 3.1 because these theories do not have algorithms and are not empirically specified.
3. *Empirical theory/prescriptive approach.* Empirical prescriptive theories are derived from the conceptual prescriptive theories and the algorithms are filled in empirically. Those algorithms can be used by the designer. Arrow *b* indicates the relation between these theories and design.
4. *Empirical theory/descriptive approach.* Empirical descriptive models are widely used in design, for example in simulation programs and in spreadsheets. The relation with the underlying conceptual theory of such models is often obscure. Those models are used in the design, indicated by arrow *c*.

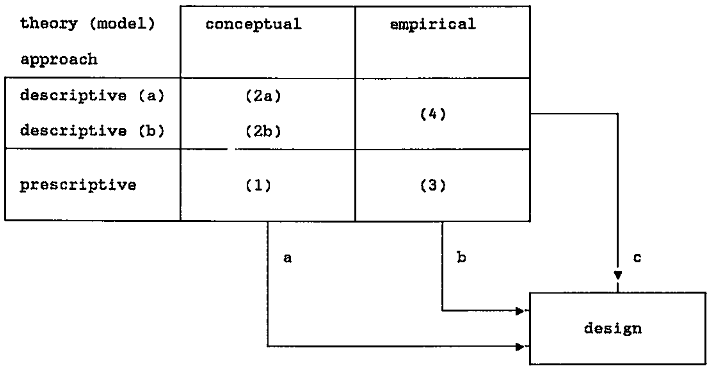


Figure 3.1: relation between theories and design, Bosman (1986:311).

Bosman (1986:312) focused in his article on arrow *c*. He argued that the lack of empirical descriptive models for the pragmatic aspect of information systems causes failures in information systems' design. He started his argumentation by saying that solving problems in organizations, like designing, implies the use of a rationality paradigm. Every solution of a problem implies a problem definition, one or more solutions and one or more criteria from which to choose. The choice of the criteria and the way they are used implicates a certain form of rationality (Bosman 1986:312). He chose bounded rationality and especially procedural rationality as a useful paradigm with regard to design. He explained that the choice of bounded rationality leads to a focus on decision-making processes in the investigation of organization problems. He also explained that the choice and the essence (of bounded rationality) implies the use of an empirical descriptive model of the design problem, which makes it possible to come up with judgments on rational designing. Bosman (1986) used rational behaviour in the way Simon (1976) had described procedural rationality:

> *'Behaviour is procedurally rational when it is the outcome of appropriate deliberation. Its procedural rationality depends on the process that generated it.'*

A process can be conceptualized as the specification of certain phases which a problem solver runs through to find a solution. Less attention has been given up to now to the relation between the paradigm of bounded rationality and the necessity of describing the existing state in terms of an empirical descriptive model, see (4) in figure 3.1. There are two ways to develop empirical descriptive models: equations models and process models. Bosman (1986) argued that the development of process models needed more attention.

The political perspective

In contrast to the rational perspective the political perspective conceives organizations as pluralistic. Organizations are divided into various interests, subunits, and subcultures (Pfeffer 1981). Politics arise because the subunits perceive matters differently and want to act differently. The goals are consistent within a coalition, but they are inconsistent within the organization as a whole (Pfeffer 1981:31). The composition of the coalitions depends on the topic of decision and the setting in which the decision process takes place. The process of decision-making is disorderly and is strongly influenced by the distribution of power within and outside the organization. Negotiations between diverse and sometimes competing interest-groups determine to a large extent the final outcome of decision processes, see for example Pettigrew (1973) and Pennings (1985).

Integration

Batelaan (1991) argued that it would be useful to combine both the rationality and politicality within one model of decision-making because these concepts represent two fundamentally different aspects. Neglecting one of them, he argued, has negative consequences for understanding the nature of decisions. Batelaan (1991) proposed that Mintzberg et al. (1976) succeeded best in integrating both concepts. Mintzberg et al. (1976) investigated 25 strategic decision processes. They identified a basic structure underlying these 'unstructured' processes. They identified 3 central phases: the identification phase, the development phase and the selection phase. The identification phase comprises decision recognition in which opportunities, problems, and crises are recognized and evoke decisional activity, and diagnosis, in which management seeks to comprehend the evoking stimuli and determine cause-effect relationships for the decision situation. In the development phase a set of activities lead to the development of one or more solutions to a problem or a crises or to the elaboration of an opportunity. The selecting phase is a multistage, iterative process, involving progressively deepening investigation of alternatives. They also identified 3 sets of supporting routines: decision control routines, decision communication routines, and political routines. Finally they identified 6 sets of dynamic factors: interrupts, scheduling delays, feedback delays, timing delays and speed ups, comprehension cycles, failure recycles.

Political perspective and IS research

For example, Markus (1983) focused on power, politics, and MIS implementation. She distinguished three theories of resistance to management information systems (MIS). Simply stated, people resist MIS, due to internal factors specific to their situation, poor system design, and the interaction of specific design features with aspects of the organizational context of system use. Data from a case study were used to illustrate the theories and to demonstrate the superiority, for implementors, of the interaction theory.

The garbage-can perspective

The third perspective in the Decision-making school is the garbage-can perspective. In their article '*A Garbage Can Model of Organizational Choice*' Cohen et al. (1972) argue that a decision is an outcome of four relatively independent streams of garbage within the organization. These streams are: problems, solutions, participants and choice opportunities. Cohen et al. (1972:16) state that: 'The garbage-can process is one in which problems, solutions, and participants move from one choice opportunity to another in such a way that the nature of the choice, the time it takes, and the problem it solves all depend on a relatively complicated intermeshing of elements'. Cohen et al. (1972) question whether decision-making is always directed to problem-solving. They argue that problems and choices are often partially uncoupled. Decision-making is thought of as being solving problems, but in reality that is often not what happens. The outcome of the interaction between the different streams of garbage depends on a complicated intermeshing of elements. Problems are worked upon in the context of some choice, but choices are made only when shifting combinations of problems or solutions, and decision makers happen to make action possible. This is sometimes the case after problems have left a given choice arena or before they have discovered it. But Cohen et al. (1972:17) conclude that:

> '*The great advantage of trying to see garbage can phenomena as a process is the possibility that that process can be understood, that organizational design*

> *and decision-making can take account of its existence and that, to some extent, it can be managed.*'

Ambiguity
March and Olson (1976) collected contributions which elaborate on the garbage-can perspective in their book '*Ambiguity and Choice in Organizations*'. By the term ambiguity they intend to signal four major kinds of opaqueness in organizations:

1. Ambiguity of intention. Many organizations are characterized by inconsistent and ill-defined objectives.
2. Ambiguity of understanding. For many organizations the causal world in which they live is obscure.
3. Ambiguity of history. The past is important, but in organizations it is easily specified or interpreted.
4. Ambiguity of organization. At any point of time individuals vary in the attention they give to different decisions. The pattern of participation is uncertain and changing.

March and Olson (1976:27) describe how the streams of problems, solutions, participants and choice opportunities are channelled by organizational and social structures. Elements of structure influence the outcomes of a garbage-can decision process (a) by affecting the time pattern of the arrival of the problems, choices, solutions or decision-makers, (b) by determining the allocation of energy by potential participants in the decision, and (c) by establishing linkages among the various streams.

3.3 Discussion

In this section the question as to how we can understand the design process of EDI systems from perspectives within the Decision-making school will be answered.

Learning, problem-solving, decision-making
In the literature, much of the discussion is about the similarities and differences between learning, problem-solving and decision-making. Learning research is concerned with the ways in which information is extracted from one problem situation and stored in such a way as to facilitate the solving of similar problems on a

subsequent occasion. Decision-makers may learn from past decisions by making a better estimation of the effects of decisions, by adjusting the objectives after experiencing the effects of past decisions or by developing more routine in decision-making (Oskam 1989:26). Problem solving research focused especially upon how a problem should be, or is being, solved. Decision-making research focused upon how a decision comes about. Problem solving and decision-making are both sides of the same coin. As Starbuck (1983:91) said:

> *'Although often equated with decision-making, problem solving is defined by its origin, whereas decision-making by its ending - a decision.'*

This study does not go into this discussion in detail. Its main focus is on decision-making.

Procedural rationality

Following the argumentation of Bosman (1986), the assumption is that solving problems, like designing, in organizations implies the use of a rationality paradigm. Every solution of a problem implies a problem definition, one or more solutions and one or more criteria on which to base the final choice. The choice of the criteria and the way they are used implies a certain form of rationality. Bounded rationality, and especially procedural rationality, is a useful paradigm with regard to design. Bosman explained that the choice of bounded rationality leads to a focus on decision-making processes in the investigation of organization problems. He also explained that the choice and the essence (of bounded rationality) implies the use of an empirically descriptive model of the design problem, which makes it possible to come up with judgements on rational designing. Takkenberg (1983) also addresses himself to procedurally rational behaviour. He argues that the development of a yard-stick for procedural rationality must always start with a description of the procedures used in the *existing* process of decision-making. Experimenting with descriptive models is a way of searching for and detecting possible improvements. With the help of a descriptive model, the improvement of new procedures over existing procedures can be shown, as Takkenberg (1983) explains. In terms of the problem definition of this study, described in chapter 1, the design process of an EDI system may viewed from a decision-making perspective. The design is the result of a process of discovery and elaboration of alternatives. In this process designers follow some steps towards the design (solution). In acting within the confines of bounded rationality they follow the phases of the decision-making process: intelligence, design, choice. The development of empirically descriptive models seems to be essential in the bounded rationality perspective.

Conceptually and empirically descriptive models

Although this study fully agrees with the argumentation of Bosman (1986) one elucidation and one extension must be made. The elucidation is on the use of the conception of design and the design process. Bosman argued for using empirically descriptive models for the design of information systems *during* the design process. Those empirically descriptive models deal with the object of design. This study goes further in arguing that these ideas can also be extended to the design process itself. The design process itself can be viewed from a procedural-rationality perspective. Empirically descriptive models of the design process itself can also help to stress problems with regard to the design of information systems in general and, more specifically, of EDI systems. These models can be used in the design process of the design process.

Lessons

The following lessons were learned from the Decision-making school perspectives:

- Design is concerned with the discovery and elaboration of alternatives. It is the second phase in a decision-making process, after the intelligence phase and before the choice phase.

- Actors behave in a procedurally-rational way in a decision-making process. Behaviour is procedurally rational when it is the outcome of appropriate deliberation. Its procedural rationality depends on the process that generated it. The effectiveness of the decision-making process, in the light of human cognitive powers and limitations, is then investigated by the procedures to choose actions.

- The choice of procedural rationality implicates the use of an empirical descriptive model of the design problem and the design process.

- The process of decision-making is sometimes disorderly and is strongly influenced by the distribution of power within and outside the organization. The outcome of a decision-making process depends on four relatively independent streams: problems, solutions, participants and choice opportunities.

3.4 The Environmental School

This section elaborates on the Environmental school within Organization Theory which focuses on the relationship between management and the environment. Decision-making as a construct is expanded to management and defined as the initiation, direction and control of purposeful activities (Kampfraath and Marcelis 1981). It relies on an open system view of the organizational world. Three different perspectives will be discussed within the Environmental school: the *contingency* perspective, the *strategic choice* perspective, and the *consistency* perspective.

The contingency perspective

Within the Environmental school, one of the dominant perspectives is the contingency perspective or structural contingency theory. For a detailed description see Van de Ven and Astley (1981) and Ten Holt (1987). Contingency theory discusses the relation between (independent assumed) situational, contextual or environmental variables and (dependent) structural variables. The central hypothesis of the contingency theory is the congruency hypothesis: 'effective structuring requires a close fit between the contingency factors and the design-parameters' (Mintzberg 1979:219), also called the consistency or fit hypothesis: 'The key concept and hypothesis ... is ... consistency or fit and its relation to effectiveness ... matching strategy and structure' (Galbraith & Nathanson 1978:1). Pfeffer (1981) puts it in another way by saying that the consonance hypothesis of the contingency perspective states that those organizations that have structures that more closely match the requirements of the context are more effective than those that do not. Lammers (1983:435) presents an overview of research in organization sociology. In his presentation he distinguishes two groups of contingency theories. The first group is on the relation between organizational structure and its appropriateness/effectiveness with situational influences acting as an intermediate variable. This group start from the central hypothesis that the appropriateness and effectiveness of organizations is dependent on the organizational structure conditioned by situational influences. The second group is on the relation between situational influences and organizational structure. Lammers (1983) identifies five sorts of situational influences: environment, technology, size, age, and power.

Within the contingency perspective, two dominant views could be distinguished. These two views are the resource-dependence view and the information-processing view. The difference in those two views lies in the conceptualization of the environment. In the resource-dependence view environment is defined as a source of depletable resources. Organizations are dependent on other organizations who compete for the same resources or provide these resources. Behaviour (and therefore the structure) of organizations could be explained by the resource dependencies. As Pfeffer and Salancik (1978:39) summarized:

> '*The underlying premise of the external perspective on organizations is that organizational activities and outcomes are accounted for by the context in which the organization is embedded.*'

Two arguments seems to be important in the resource-dependence view (Pfeffer 1982):

. The first argument deals with *external constraints*. Organizations will respond more to the demands of those organizations that control critical powers;

. The second argument deals with *managing external dependencies*. Managers attempt to manage their external dependencies, both to ensure the survival of the organization and to acquire, if possible, more autonomy and freedom from external constraint.

In the information-processing view attention is given to the decision-making processes within the organization and the uncertainty surounding the decision-making. Information on the environment will be used by decision-makers in the organization to hold or change the strategy, processes and structure. The perception of information is the intervening variable between the environment and the activities of the organization. One of the dominant researchers in the information-processing field is Galbraith (1973). He views organizations as information-processing systems. Organizations have a good structural fit if the information-processing capacity of the organization structure fits the information-processing demands of the environment and the technology.

The resource dependence view and information-processing view have made the functional relationships between organization and environment explicit. A contingent relationship is a functional relationship between two or more variables. Contingency management is concerned with the relationship between relevant environmental variables and appropriate management concepts and techniques that lead to effective goal attainment (Luthans 1976:29). The external environmental variables are the independent *if's*, and the management variables are the dependent *then's* in the contingency relationship. For example, *if* the economy is undergoing a recession and the firm operates in an oligopolistic market structure, *then* a bureaucratic organization structure would be most appropriate for goal attainment.

The major difference between situational and contingency approaches is that a contingency approach implies that there is a functional relationship between designated environmental conditions and the appropriate management concepts and techniques for effective goal attainment. The environment does not cause the management concepts and techniques to occur. Rather there is merely a functional relation between the independent environmental variables and the dependent management variables.

Environmental variables

The external environment is outside the formal organization system and can be divided into a general and a specific classification (Luthans 1976:50). The general external environment loosely consists of social, technical, economic, and political/legal forces. The specific environment loosely includes suppliers, customers, and competitors. The internal environment is essentially the formal organizations system. The major internal variables include the organizational structure, the processes of decision-making, communication and control, and the organizational state of technology.

The environmental dimension most often considered is uncertainty. Burns and Stalker (1961) were among the first to notice that different environmental conditions made different organizational structures more or less appropriate. They found that a mechanistic, or bureaucratic organizational, structure was appropriate for more stable and certain environments, while an organic, less formalized and centralized structure was found more frequently and was more successful in rapidly changing environments. Lawrence and Lorsch (1967) argued that different organizational units faced different sub-environments and that, for instance, the environment of a production department was very different from that faced by marketing or research and development. They argue that each subunit would develop a structure matching its own subenvironment, therefore leading to a higher degree of differentiation within the organization. The higher the degree of differentiation, the more difficult it is to coordinate and integrate the entire system. Pfeffer and Salancik (1978) argued that the three basic dimensions of the environment were the degree of concentration of resources, the scarcity or munificence of the resources, and the degree of interconnectedness of the organizations.

Mintzberg (1979) distinguishes the following contingency factors: age of the organization, size of the organization, technical system, environment, power. With regard to the environment Mintzberg (1979) argues that four characteristics of organizational environment are discussed in the literature. They are stability, complexity, market diversity, and hostility. Mintzberg (1979) construct four hypotheses on these characteristics. These are:

- The more dynamic the environment, the more organic the structure;
- The more complex the environment, the more decentralized the structure;
- The more diversified the organization's markets, the greater the propensity to split into market-based units (given favourable economies of scale);
- Extreme hostility in its environment drives any organization to centralize its structure temporarily.

He also constructed a fifth hypothesis which considers the effect of dimensions that impose contradictory demands on the structure of organizations. This hypothesis is:

- Disparities in the environment encourage the organization to decentralize selectively to differentiated work constellations.

With regard to the contingency factor power, Mintberg (1979) identifies three power factors: the presence of outside control of the organization, the personal needs of its various members and the power of social norms. At this moment the first one is important. The hypothesis is as follows:

- The greater the external control of the organization, the more centralized and formalized its structure.

The two most effective means to control an organization from outside are (1) to hold its most powerful decision-maker responsible for its actions, and (2) impose clearly-defined standards on it. The first centralizes the structure, the second formalizes it.

Management variables

The management concepts and techniques can be classified into process, quantitative, behavioural, and systems categories. It recognizes that all four major schools of management thought can make a significant contribution to contingency management (Luthans 1976:52). Process management variables deal with planning, organizing, directing, communicating, and controlling. Quantitative management variables deal with basic quantitative methods, decision models, and operations research. Behavioural management variables deal with learning, behaviour modification, motivation and group dynamics. System management variables deal with general system theory, system design and analysis, and management information systems.

Contingent Relationship

The functional relationship is the central proposition of contingency management. It represents the goal of any scientific pursuit - the determination of functional relationships which lead to improved understanding, prediction, and control (Luthans 1976). It must be recognized that once a given contingency relationship is empirically established, this is only one input into what action management will eventually implement in actual practice.

Contingency perspective and IS research

Weill and Olson (1989) reviewed 16 issues of JMIS and 26 issues of MIS Quarterly (two leading management information systems (MIS) journals), for the period March 1982 through June 1988 representing 177 articles in total. Of these, 105 (59 percent) were empirical and they reviewed each of these in detail. For each of these articles the contingency variables, MIS variables, MIS performance, organizational performance and comments were described. There was an overwhelming preponderance of the contingency model in MIS research. Indeed over 70 percent of the empirical studies in these two journals show some use of a contingency model, whether explicit or implicit (Weill and Olson 1989:76).

Weill and Olson (1989) focus on the application of the contingency theory with regard to management information systems. They define the contingency theory as follows:

> '*The contingency approach attempts to understand the interrelationships within and among organizational subsystems as well as between the organizational system as an entity and its environments. It emphasizes the multivariate nature*

of organizations and attempts to interpret and understand how they operate under varying conditions ...' (Weill and Olson 1989:60).

There are a number of important assumptions underlying contingency theory. These are:

- *Fit.* Contingency theory assumes that the better the 'fit' among contingency variables (e.g., between technology and organizational structure), the better the performance of the organization.
- *Performance.* Performance may or may not be actually measured in the study; when it is, it is generally narrowly defined by financial measures such as return on investment, profit, or net worth.
- *Rational actors.* The theory assumes that organizational actors perform in ways that are always in concert with the superordinate goal of organizational effectiveness. As a consequence, there is goal consensus among decision makers within an organization. If the critical variables requiring 'fit' were known, organizational decision makers would adapt the organization to a better fit.
- *Equilibrium.* An organization with 'fit' is at equilibrium, and performance is a result of that equilibrium. There is no time lag between the independent variables and their impact on organizational performance.
- *Deterministic model.* Although the methodologies employed do not generally allow conclusions about causality, clear causal inference is often made.

For example, Tait and Vessey (1988:93) who used the contingency perspective in IS research, state that 'Contingency theory acknowledges that certain variables may affect the outcome of a particular process. Contingency theory itself has no content; it is merely a framework for organizing knowledge in a given area. Therefore, if we are to draw on contingency theory (...) we must draw on well-established contingency theories from other disciplinary areas as well from prior research in information systems'.

The strategic choice perspective

The second perspective in the Environmental school is the strategic choice perspective. Child (1972) criticized the contingency perspective for neglecting the importance of strategic choice. He argued that:

- Organizations were not as tightly coupled to environments as implied by the contingency perspective;
- Profits and effectiveness were not the only outcomes of interest to those in the dominant coalition who determined the structure;
- The effects of the environments were mediated through the filter of managerial perceptions.

The direct source of variation in formal and structural arrangements is not the context of the organization, but the strategic decision-making process of the dominant coalition. The strategic decisions are influenced by the evaluation of the environment by the dominant coalition. The strategic choice perspective constitutes a neo-contingency metaphor emphasizing the importance of decision makers who serve as the link between organizations and environments (Miles and Snow 1978). Empirical studies based on the strategic choice concept extend the contingency metaphor by also allowing for environments as acts of managerial invention rather than mere discovery. One example of an empirical study is the work of Miles and Snow (1978). They describe the process by which prospectors, defenders, analyzers and reactors enact and respond to their environments. They found that a mix of strategic types tended to coexist in the sense that one could find a mix of strategic postures within the same industry, and even within the same local environment within that industry.

Strategic perspective and IS research

In his article '*Information Technology, Organization, and the Response to Strategic Challenges*' Child (1987) explores the contribution of IT towards the different modes of organizing transactions that are being adopted within the contemporary strategic context of mature economies. IT is not the determinant of organization, though it certainly extends the range of possibilities. Child (1987:47) argues that

> '*Probably the most significant area of change at the present time lies in the development of coordinated contracting arrangements by previously integrated*

firms. Here the key managerial requirement is to apply the same degree (though not kind) of control and coordination to transactions within a chain or network of firms as could be applied within one integrated firm.'

Child concludes with the statement that in particular IT can facilitate the process of externalization, which has been encouraged by strategic challenges.

Schrama (1991) argued that the strategic choice perspective is suitable to represent the relationship between organization and technology. The strategic choice perspective is concerned with freedom of choice with respect to the environment, the organizational domain and the organizational form. Schrama (1991) focused on the true freedom of choice related to the organizational form by the introduction of new information technology. He examined the introduction of personnel information systems for eight municipal organizations. He identified two clusters of variables dealing with decentralization and coordination. Within each typology three types could be distinguished. Out of nine possible combinations, there were six present at the study, all of which differed significantly from one another. A substantial freedom of choice in organizational forms was reported. No conclusions could be reported with respect to the organizational form of the personnel functions being determined by situational factors.

The consistency perspective

An answer on the contingency and strategic choice perspective has recently been formulated by Broekstra (1986). He tried to overrule the problems by developing a so-called consistency model at a higher abstraction level. The model is centred around two relevant questions within an organization. Those questions are:

1. What business are we in? This question deals with the external stability. The question will be answered in an organization by two aspect systems: the entrepreneur system and the technology system.
2. What organization do we need? This question deals with the internal stability and will be answered by the management system and the socio-psychological system.

Every internal aspect system has an equivalent environmental aspect system. These are respectively business structural developments, technological developments, managerial-structural developments, labour market- and social developments. The four internal aspect systems are the entrepeneur system, the technological system, the managerial system, and the social-psychological system. Broekstra (1986) also distinguished the political system viz. the dominant coalition. The central proposition of the model is the mutual consistency between the aspect systems. There has to be consistency between the powers of the environment and the actions and reactions of the organizations, between the internal structure and functioning of the organizations, and between the aspect system and their external counterparts. Differences between the contingency and consistency perspective are the following:

- In the contingency perspective, variables have a functional and a non-interaction relationship. In the consistency perspective, variables have an explicit interactional relationship.
- In the contingency perspective, variables are described in terms of relations between variables. In the consistency perspective, variables are described in terms of changes in and interactions between aspect systems.
- The contingency perspective deals with matching and the factor 'time' is not dominant. The consistency perspective deals with searching for equilibrium and stability. The factor 'time' plays a dominant role.

Consistency perspective and IS research

One of the first researchers in the field of Information Management to adopt the consistency perspective and apply it in relation to the development of information systems was Brevoord (1991). He distinguished four aspect systems. They are the information provision system, technical infrastructure, organizational infrastructure, and social infrastructure. Those systems are related with the dominant coalition. The information household is mutually influenced by other application areas within the organization and the environment. Variables related to the environment, related to the organization and related to a concrete project, influence basic choices related to the information household. Breevoord argued that one of the reasons for automatization projects failing was that the situationality of a project was often not recognized. So specific organization or project circumstances were not adequately catered for.

3.5 Discussion

In this section the question of how we can understand the design process of EDI systems from perspectives within the Environmental school will be answered.

Strengths and Weaknesses
In the literature reports are given of the strengths and weaknesses of the contingency perspective. The strengths encompass:

- *Concept of situationality.* The concept of situationality is an important strength compared with the classical theories of Taylor, Fayol and Weber. Instead of 'there is one best way to organize' the contingency perspective proclaims the statement 'there is no best way to organize'. Dependent (internal) organizational variables are influenced by independent (external) environmental variables.
- *Empirical refutation.* One of the assumptions of the contingency perspective is the deterministic model. Although the research approaches employed do not generally allow conclusions about causality, claims of clear causal inference are often made. The use of causal inference makes it possible to identify simple causal - effect relations which can be researched statistically.
- *IS research.* Within the field of Information Management their is a preponderance of contingency models in IS research. Knowledge is available on the development and results of these models.

Schoonhoven (1981) suggest that there are five problems with the contingency perspective. These five problems or weaknesses encompass:

- *Lack of clarity.* The contingency theory is not a theory at all, in the conventional sense of theory of a well-developed set of interrelated propositions. It is more an orienting strategy or metatheory, suggesting ways in which a phenomenon ought to be conceptualized or an approach to the phenomenon ought to be explained.
- *Contingency relations as interactions.* Lack of clarity blurs the fact that an empirical interaction is predicted. When it is asserted that there is a relationship between two variables which predict a third variable, they are stating that an interaction exists between the first two variables.

- *Functional forms of interaction.* Theoretical statements fail to provide any clues about the specific form of the interaction intended. A theory interpretation could be multiplicative or it could be a 'matching' or 'maximizing' theory. Depending on one's interpretation of the theorists' ideas, contingency theory is capable of producing precise hypotheses as well as corresponding functions.
- *Analytical model used.* The operational and computational procedures that researchers tend to use assume that the relationships studied are linear. This sometimes misplaced assumption of linearity is important for two reasons. The researcher fails to check for nonlinear relations. Second, the assumption of linearity masks the fact that contingency relations are symmetrical.
- *Assumptions about contingency relationships.* An assumption of symmetrical effects is hidden in the language of the contingency theory. Its suggests a nonmonotonic effect of the independent variable over the dependent variable, in stead of the usual assumption that an effect is constant over all values of the independent variable.

Also Weill and Olson (1989:67) reported some weaknesses related to the contingency perspective used in information systems research, like use of naive meta-theory, conflicting empirical results, ill-defined concepts of fit and performance, and the narrow perspective of researchers. Weill and Olson (1989) argued that they saw that as an unnecessary restriction if applied to organizational research which has flourished since the emergence of multiple theories. MIS research, they conclude, can only benefit from the exploration of additional paradigms. Most weaknesses are related to operationalization and measurement. The fundamental propositions of the contingency perspective seem to be embraced.

The overall conclusion with regard to the contingency perspective addressed by Schoonhoven (1981:350) was that:

> '*Contingency theory is not a theory at all, in the conventional sense of theory as a well-developed set of interrelated propositions. It is more an orienting strategy or meta-theory, suggesting ways in which a phenomenon ought to be conceptualized or an approach to the phenomenon ought to be explained... Although the overall strategy is reasonably clear, the substance of the theory is not clear.*'

It seems to be that much more precisely stated and potentially falsifiable hypotheses ought to be related to the specific problem stated. The testing of these hypotheses requires more attention to the operationalization and measurement of the variables.

Environment and EDI systems

The central element in the three perspectives is (obviously) environment. Two issues are important to the discussion: the role of EDI and the subjectivity of the environment. The first issue deals with the role of EDI. Environment can be specified as the general external environment, the specific external environment and the internal environment (the formal organization). The relation environment - organization is in practice and science mostly viewed from a single organization point of view or from a general point of view. In the Environmental school, different definitions of environment and organization and also different interactions between environment and organization are to be found. In relation to EDI it is possible that:

- EDI can be viewed as a subspecies of Information Technology, in which case should be part of the Environmental school falling under Technology. Technology will influence the internal structure of organizations;
- EDI can be viewed as a general external environmental factor which influences the production sector in a country and therefore the competitive advantage of the nation;
- EDI can be viewed as a specific environmental factor which influences the position of an organization in relation to its suppliers, customers and competitors.

In all these three views EDI is an external force which changes the internal structure of organizations. On the other hand, by using EDI organizations have the opportunity of restructuring their environment. The external data communication with suppliers and customers can be redesigned. Organizations have to negotiate, coordinate and develop their EDI system with other organizations (their environment). Sometimes EDI causes a restructurering of the environment or perhaps it would be better to say organizations capture a part of their environment.
A second issue to be raised is the subjectivity of the concept environment. In the early stages of the development of EDI systems, actors might define the specific environment as the organizations which might or might not participate in the development of the EDI system. At the end of the development process they might

define the specific environment as the organizations outside the EDI project or even the actors outside the EDI project - even if they belong to their own organization.

Lessons
The following lessons were learned from the Environmental school perspectives:

- Management is defined as the initiation, direction and control of purposeful activities.

- Contingency management is concerned with the relationship between relevant environmental variables and appropriate management concepts and techniques that lead to effective goal attainment. Related to the design process of EDI systems, this means that contingency management of the design process is concerned with the relationship between relevant environmental variables of the design process and appropriate management concepts, and techniques of the design process that lead to effective goal attainment.

- The direct source of variation in formal and structural arrangements is the strategic decision-making process of the dominant coalition.

- In using constructs of the Environmental school one has to pay attention to the definition of those constructs and the quantification strategy in terms of carefully-chosen research approaches and research material.

3.6 Summary

The following questions were answered in this chapter:

- How can the design process of EDI systems be understood as seen through the eyes of adherents to the Decision-making school?

- Design is concerned with the discovery and elaboration of alternatives. It is the second phase in a decision-making process after the intelligence phase and before the choice phase. Actors behave in a bounded, or in a more specifically procedurally-rational way in a decision-making process. Behaviour is procedurally rational when it is the outcome of appropriate deliberation. Its procedural rationality depends on the process that has generated it. The effectiveness of the decision-making process is then investigated by the procedures for choosing actions, in the light of human cognitive powers and limitations. The choice of procedural rationality implicates the use of an empirically descriptive model of the design problem and the design process. The process of decision-making is sometimes disorderly and is strongly influenced by the distribution of power within and outside the organization. The outcome of a decision-making process depends on four relatively independent streams: problems, solutions, participants and choice opportunities.

. How can the design process of EDI systems be understood as seen through the eyes of adherents to the Environmental school?

- Management is defined as the initiation, direction and control of purposeful activities. Contingency management is concerned with the relationship between relevant environmental variables and appropriate management concepts and techniques that lead to effective goal attainment. There is a functional relationship between designated environmental conditions and the appropriate management concepts and techniques for effective goal attainment. The environment does not cause the management concepts and techniques to occur: the relationship is merely functional. The strategic decision-making process of the dominant coalition plays a relevant role. The direct source of variation in formal and structural arrangements is the strategic decision-making process of the dominant coalition. Using constructs of the Environmental school one has to pay attention to the definition of those constructs and the quantification strategy in terms of carefully chosen research approaches and research material.

4 DESIGN MANAGEMENT THEORY

4.1 Introduction

In chapter 2 the problem stated was investigated from a practical point of view. In chapter 3 the problem stated was investigated from a theoretical point of view. Practice and theory provide a foundation for a conceptual model with regard to the explanation of EDI system-design success. This study follows the argumentation that a theory is a necessary guideline in systematic research (see Van de Ven 1989; Whetten 1989). In this chapter a theory will be developed called Design Management Theory for EDI systems. This study integrates constructs of the two schools investigated and use these in an interorganizational context. The following questions will be answered:

- What are relevant constructs derived from the lessons learned from the Decision-making and Environmental school in relation to the problem stated?
- What are relevant propositions in that respect?
- What are relevant variables in the research model?
- What are relevant hypotheses in the research model?

In section 4.2 the lessons from the previous chapters will be summarized and the relevant constructs and propositions will be described. Important constructs in that respect are those of the contracting environment, contracting management, contracting success, design environment, design management and EDI system-design success. In the next sections 4.3 - 4.8 these constructs will be defined and refined into relevant variables and indicators. In section 4.9 the relationships between the variables as hypotheses will be presented.

4.2 Constructs and propositions

A theory may be viewed as a system of constructs and variables in which the constructs are related to each other by propositions and the variables are related to each other by hypotheses (Bacharach 1989). Bacharach (1989:500) defines constructs as terms which, though not observable either directly or indirectly, may be applied or even defined on the basis of the observables. A variable may be defined as an observable entity which is capable of assuming two ore more values. So, propositions state the relations between the constructs, and on a more concrete level, hypotheses (derived from the propositions) specify the relations between the variables. Theories are constrained by their specific, critical, and bounding assumptions related to values, time and space. The goal of theory is to diminish the complexity of the empirical world on the basis of explanations and predictions (Bacharach 1989:513). In this section relevant constructs and propositions will be identified. The constructs and propositions described are derived from the previous two chapters. The lessons learned from the practical investigation of the problem stated in chapter 2 were:

- EDI systems are business facilities to exchange structured and normative data between computers of transactions-related organizations. The quality of EDI systems seems to be of increasing importance. The development of EDI systems in practice follows the information system life cycle and is project-oriented. Within the development life cycle, processes and products could be distinguished. In practice, attention is paid to strategic aspects of EDI. In most situations EDI is introduced into organizations by way of pilot projects.

The lessons learned from the theoretical investigation of the problem stated belong to two schools. It was learned from the Decision-making school:

- Design can be defined as the discovery and elaboration of alternatives. Actors may behave in a procedurally rational way in a design process. The effectiveness of the design process can be investigated by the procedures involved in choosing to take certain actions. The process of decision-making is sometimes disorderly and is strongly influenced by the distribution of power within and outside the organization.

The lessons learned from the Environmental school were:

- Design activities can be managed. Design management can be defined as the initiation, direction and control of design activities. There seems to be a functional relationship between designated, environmental conditions and the appropriate management concepts and techniques for effective goal attainment. The environment does not cause the management concepts and techniques to occur: the relationship is merely functional. The strategic decision-making process of the dominant coalition plays a relevant role.

From these lessons and the problem stated in the introduction, this study integrates those constructs into one research model which could explain the success or failure of EDI system design. The basic unit of study is the EDI project. An EDI project is defined as the interorganizational collection of resources to develop and implement a unique EDI system. Three important distinctions will be made in the research model, bearing in mind the lessons learned from the Decision-making school and the Environmental school.

The *first* distinction is made between contracting process and design process. The contracting process is defined as: the course of contracting management and contracting activities resulting in a cooperation contract for the development of an EDI system between transactions-related organizations. The input of the contracting process is the initiative taken by one or more organizations. The output of the contracting process is the cooperation contract. The design process is defined as the course of design management and design activities resulting in an EDI system design. The input of the design process is the cooperation contract. There are also more autonomous inputs like human resources, knowledge and information. This study focuses on the cooperation contract as input. The output of the design process is the EDI system design.

The *second* important distinction is made between management and activities. Management deal with the decision-making part of the process. Activities deal with the execution part of the process. This study focused on the management component e.g. contracting management and design management.

The *third* distinction is made between management and environment. Contracting environment and design environment were distinguished.

The following constructs are of importance. First, the constructs were defined and in the next sections they will be discussed in more detail.

- *EDI system-design success.* The problem stated deals with the question of success or failure of EDI system design. The effectiveness of the design process can be related to the product of that process viz. EDI system-design success. The construct EDI system-design success is defined as the way the realized EDI system design meets the planned requirements.
- *Design management.* Design activities can be managed in terms of initiation, direction and control. Appropriate management concepts and techniques can lead to effective goal attainment in terms of EDI system-design success. The construct design management is defined as decision-making dealing with the initiation, direction and control of design activities.
- *Design environment.* Effective design management is related to its context viz. design environment. External EDI project variables have a functional relationship with the (internal) design process within the EDI project. Design environment are those external variables which have a functional relationship with the design management within an EDI project.
- *Contracting success.* The effectiveness of the contracting process can be related to the product viz. if the organizations have been able to set up and specify an interorganizational cooperation contract or agreement. The construct contracting success is defined as the level of specification of the cooperation contract.
- *Contracting management.* Contracting activities can be managed in terms of initiation, direction and control. This study defines contracting management as decision-making dealing with the initiation, direction and control of contracting activities.
- *Contracting environment.* Effective contracting management is related to its context viz. contracting environment. External EDI project variables have a functional relationship with the (internal) contracting process within the EDI project. Contracting environment covers those external variables which have a functional relationship with the contracting management within an EDI project.

The relationships between those constructs are derived from the lessons learned from both of the schools investigated, see for example Achterberg (1986), Luthans (1976), Simon (1982), Weill and Olson (1989). The following two propositions can be formulated:

Proposition 1: Contracting success is affected by contracting management and its contracting environment.

Proposition 2: EDI system-design success is affected by design management, its design environment and contracting success.

Now the constructs and propositions have been described, the general research model will be presented, see figure 4.1. It illustrates the two propositions investigated in this study.

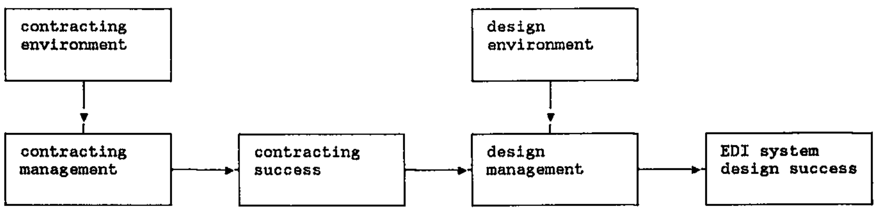


Figure 4.1: general research model explaining EDI system-design success.

In the next sections the constructs will be refined on a more concrete level and relevant variables which could represent the constructs will be chosen. The variables will be further refined in indicators. Each of the constructs and their variables will be discussed in the following sections. The hypotheses, as the specification of the relations between the variables, are defined. The general research model will be discussed, working from left to right, thus following the life cycle of an EDI system.

4.3 Contracting Environment

The construct contracting environment is refined into the variable level of cooperativeness of the contracting environment e.g. the sector in which the EDI project is situated. Level of cooperativeness of the contracting environment is defined as the way organizations in the sector, related to the EDI project, are working together. In this section the argumentation for this variable will be presented and will be refined by looking for relevant 'level of cooperativeness' indicators.

In the field of strategic management theory, many studies demonstrate the relationships between environment and management, see Van Heck and Zuurbier (1989); and Zuurbier and Van Heck (1991). For example, De Jong (1991) in his article '*Competition,* *concentration and the European Competition Policy*' tries to answer the question why organizations start to cooperate. He presents a Competition Cycle Framework. He identifies three important functions for every organization in a market economy:

- An organization should organize its production process efficiently, that is to say that an organization should combine its resources to arrive at the lowest costs;
- An organization should remove uncertainties and control them as best they can;
- An organization should introduce innovations.

These three organizational functions create a surplus value or margin. It is the creative competition of phase 1. But in a market economy, the surplus value or margin will be tempted into imitating and emulating competitors, this is phase 2. Internal and external restructuring is required - especially for the losers. External restructuring is concentration or cooperation. This is done to create structural conditions to overcome the threat or to create a lead by a new fulfilment of the three functions. This is called the structural competition of phase 3. The framework is timeless and spaceless, and identifies no institutions for the regulation of market transactions. The framework does not identify sectors. The key hypothesis of the framework is that: 'restructuring is a reaction to more intensive competition (phase 1 and 2) and a condition for the start of a new competition round (phase 3)' (De Jong 1991). The growth cycle and market cycle influence the competition process. Expansive growth cycles decrease the concentration level. Stagnation and decline increase the concentration. De Jong (1991) demonstrates this for the economies of (West) Germany, the United States and Japan. Besides growth cycles there are shorter market cycles. They have a different pattern in sellers- and buyers markets. De Jong argues that sellers markets, rather than buyers markets, motivate the forming of strategic alliances and acquisitions and mergers. Strong organizations which create margins in a sellers market, use these margins to buy lower-priced organizations (sometimes competitors) in a buyers market. Weak competitors are keen to cooperate in a declining market-cycle phase. De Jong (1991) also considers the institutional conditions which can regulate the markets. These differences in institutional conditions influence the behaviour of organizations. It was decided that the following indicators from De Jong's framework would be used. Each indicator is indicated by a letter and a number related to the question in the questionnaire. The questionnaire will be discussed in detail in chapter 5. The chosen indicators are :

D1 *Level of competition between organizations*. This indicator indicates the level of intensiveness of the competition between organizations in one sector. If the level of intensiveness of the competition increases the level of cooperativeness of the sector decreases.

D2 *Stage of the growth cycle*. This indicator indicates the growth of the sector. If the sector is in a later stage of the growth cycle the level of cooperativeness of the sector increases.

D3 *Stage of the product/market cycle*. This indicator indicates the growth for a specific product/market combination. If the product/market combination is in a later stage of the product/market cycle the level of cooperativeness of the sector increases.

Harrigan (1986) researched the cooperation process viz. the forming of joint ventures between organizations. She examined 492 joint ventures and 392 other cooperative strategies to uncover what makes them successful (or unsuccessful) and why they work differently in different situations. Given shorter product lives, maturing domestic economies, the explosive effect of technological improvements on communications, computers, biotechnology, and other arenas where industrial boundaries were formerly distinct, and given that many industries have become global in their scope of competition, Harrigan addresses the problem of how managers are analyzing the use of joint ventures. She constructed a Joint Venture Framework. The framework covers the dynamics of relationships between:

(1) Owners as partners;
(2) Between owners and their ventures;
(3) Between the venture and its competitive environment as these concerns affect the viability of joint-venture strategies for their owners.

The resources and attributes that partners will share with their venture affect both their willingness to form a joint venture and each partner's relative bargaining power therein. Whether the bargain that partners strike in cooperating will take the form of a joint venture (or other form of cooperative arrangement) depends on the bilateral bargaining power among partners and on other forces (Harrigan 1980:31). This initial balance of power will evolve over time due to the effects of many internal and external forces of change. Bargaining power is determined by benefits, costs, resources, alternatives, need and barriers. This indicator was chosen from Harrigan's framework (1986):

D4 *Level of bargaining power distribution between organizations*. This indicator indicates the distribution of bargaining power between the organizations in the sector. If the bargaining power is more distributed and not concentrated in one or a few organizations the level of cooperativeness within the sector decreases.

Porter (1985) in his book '*Competitive advantage*' focused on the competition in the branches. One of the elements is the coalition-forming in the branches. Coalitions are long term agreements between organizations, which are situated between normal market transaction and a total take-over. One of conditions for creating successful coalitions seems to be the level of organization with regard to EDI in the sector. De Bruijn et al. (1990) made it clear that the organization level, in terms of the existence of branch-organizations and EDI organizations in the sector, is an important factor for the successful introduction of EDI in one sector. They indicated that:

- The existence of a good level of organization promotes the implementation of EDI;
- The extent to which the existing (branch) organizations are accustomed and prepared to cooperate determines the successfulness of EDI;
- The existence of an EDI organization within the sector will be a condition for a smooth implementation of EDI because it creates a certain awareness.

Therefore the following indicator was chosen:

D5 *Involvement of Branch/EDI organizations*. This indicator indicates the involvement of branches and/or EDI organizations of the sector in the EDI project during the contracting process. If there are branches and/or EDI organizations involved the level of cooperativeness of the sector increases.

4.4 Contracting Management

The construct contracting management is refined in the variable level of contracting management. The level of contracting management is defined as the way the decision-making dealing with the initiation, direction and control of contracting activities is controlled and measured. In this section the argumentation for this variable will be presented and will be refined by looking for the relevant 'level of contracting management' indicators.

Again, in the field of strategic alliances or joint ventures, research focused on the managing of these processes (Devlin and Bleakley 1988). For example, Schreuder and

Van Witteloostuijn (1991:118), quoting Business Week (July 21, 1986), identified a failing percentage of strategic alliances of 70%. They argue that a great percentage of strategic alliances start as a success but finish as a failure. One form of strategic alliance they identified is system integration. Schreuder and van Witteloostuijn (1991) describe the case where organizations decide to partly design their strategic systems in a network cooperation, for example hotel reservation systems or cooperative logistical systems. The mix of internal control mechanisms and external affection mechanisms determined, as they pointed out, the character of the strategic alliance. Huyzer et al. (1990) distinguish phases within the process of strategic alliance. These phases are strategic analysis, partner choice, implementation of the strategic alliance and the evaluation of the strategic alliance. For each phase Huyzer et al. (1990) identify key factors. Some of these key factors will be used as indicators for the level of contracting management. These key factors are:

- *Strategic analysis*. Worldwide developments, external analysis, product/market life cycle, internal analysis, competitive advantage, strategic plan;
- *Partner-choice*. Profile-definition, partner-search, partner-review, negotiations, cooperation plan;
- *Implementation*. Legal, fiscal and financial aspects, human resource management;
- *Evaluation*. Objectives strategic alliance, objective partners.

Contracting management indicators

The following indicators are identified as essential to measure the level of contracting management. These indicators are:

C1 *Level of strategic planning*. The level of strategic planning indicates if attention was given to strategic aspects of the cooperation. If attention is given to strategic aspects the level of contracting management increases.

C2 *Level of costs/benefits attention*. The level of costs/benefits attention indicates the attention given by the organizations to the costs and benefits of EDI for the organizations. If more attention is given to costs and benefits the level of contracting management increases.

C3 *Level of demonstrable benefits attention*. The level of demonstrable benefits attention indicates the attention which is given to demonstrate the benefits of EDI for the organizations. If more attention is given to demonstrate benefits the level of contracting management increases.

C4 *Level of partner choice*. The level of partner choice indicates the way participating organizations were chosen. If partner choice is done in a procedural way the level of contracting management increases.

C5 *Level of human resource management*. The level of human resource management indicates the way human resources were chosen to represent the organizations in the contracting process. If the level of human resource management increases the level of contracting management increases.

C6 *Level of mutual trust between actors*. The level of mutual trust and openness indicates the atmosphere between the organizations during the contracting process. If the level of mutual trust increases, the level of contracting management increases.

C7 *Level of planning*. The level of planning indicates the way the contracting process was systematically planned. If the contracting activities are more systematically planned the level of contracting management increases.

4.5 Contracting Success

The construct contracting success is refined in the level of specification of the cooperation contract. This paragraph focuses on that level of cooperation contract specification.

Harrigan (1986) focused on the bargaining agreement which covers outputs, inputs, control mechanisms, duration or stability of the agreement. As Humphrey (1989:420) argues: once agreement is reached on requirements, it is necessary to agree on a plan for the work and then to track progress against it. This plan may include documentation and approval of the requirements and it must include the necessary verification to show that the work has been done properly. These activities are essential with regard to managing the process. Humphrey (1989:411), Huyzer et al. (1990:87) and Turner (1990:287) elaborate on the specification of contracts. The following refinement was chosen:

E4 *Level of specification*. The level of specification of the cooperation contract indicates the number of aspects the cooperation contract deals with. If the level of specification increases contracting success increases.

4.6 Design environment

The construct design environment is refined into the variable level of stability of the design environment e.g. organizations in the EDI project. Level of stability is defined as the amount of turbulence and uncertainty with regard to the organizations in the EDI project. In this section this variable will be discussed and will be refined by looking for relevant 'level of stableness' indicators.

Nolan (1979) was the first among researchers in the field of Information Management who developed a stage model and identified the level of automatization of organizations in his so-called Nolans stage theory. He argued that information technology (IT) is absorbed by organizations following certain stages. He distinguished six stages: initiation, contagion, control, integration, data administration and maturity. Each stage could be distinguished by its view of automatization, the used soft- and hardware, and the arguments for using IT. Although there are criticisms of the Nolan stage theory dealing with the empirical falsificability, the validity of the theory has in fact been tested. Results do not give a clear empirical evaluation. It seems to be interesting to investigate whether the level of automatization of the participating organization influences the design management within the EDI project.

De Bruijn et al. (1990) argue that the level of automatization is important with regard to the applicability of EDI in a sector. They said that implementation of EDI:

- Is easier if a number of partners have good information systems at their disposal;
- Is easier if (bilateral) solutions already exist with regard to communication between partners;
- Is easier if universal codes exist.

Raymond (1990) investigated the organizational context and information systems' success. He related organizational size, maturity, resources, time frame and IS sophistication to user-satisfaction and system usage. The model was tested by means of an empirical investigation of 34 small and medium-sized manufacturing firms. The results indicate that while organizational time frame and IS sophistication have a direct effect upon satisfaction and usage, the effect of size, maturity, and resources is mediated by IS sophistication.

Design environment indicators
Indicators were chosen related to the organizations participating the EDI project. These organizations are the direct environment of the EDI project. The following indicators were chosen:

I1 *Level of automatization.* The level of automatization indicates in which stage of the Nolan model organizations are and how they deal with automatization. If organizations are in a higher Nolan stage, the level of stability of the organizations increases.

I2 *Differences in automatization level.* The differences in automatization level indicates the differences between the organizations in terms of their automatization level related to the automatization level of the other organizations. If the differences decrease, the level of stability of the organizations increases.

I3 *Level of organizational changes.* The level of organizational changes indicates the organizational changes during the design process by the organizations. If there are fewer organizational changes, the level of stability of the organizations increases.

I4 *Level of organization size.* The size of the organizations indicates the number of persons affiliated to the organizations. If the organization size increases, the level of stability of the organizations increases.

A fifth indicator is added which might indicate the stableness, or more specifically the uncertainty, of the environment, see for example De Bruijn et al. (1991a) and (1991b). It is related to the uncertainty about the legal and fiscal status of the (to be designed) EDI messages during the design process. The indicator is:

I5 *Level of uncertainty of legal/fiscal status of EDI messages.* The level of uncertainty indicates the uncertainty with regard to the legal status of the EDI messages to be designed. If the status is more certain, the level of certainty of the organizations increases.

4.7 Design management

The construct design management is refined in the variable level of design management. The level of design management is defined as the way the decision-making dealing with the initiation, direction and control of design activities is controlled and measured. In this section this variable will be discussed and will be refined by looking for relevant 'level of design management' indicators. First, this section focuses on the field of software engineering. Second, the literature on the development of intra- and inter-organizational information systems will be investigated. Third, the design management indicators will be presented.

Management can be divided into three subsections. These are strategic management, resource management and operational management. Strategic management deals with the tuning of objectives and resources. Resource management deals with the buying and maintenance of resources. Operational management deals with the planning of activities to be executed and the methods and techniques to perform these activities, see Kampfraath (1978); Kampfraath and Marcelis (1981); Bots et al. (1989); Bots et al. (1990); Bots (1991); and Zuurbier et al. (1991). A clear distinction is made between management and execution. Decisions are the result of managerial processes. Physical changes are the result of executive processes. This section looks for the relevant level of design management indicators. One of the first studies to investigate the management of, what he called, the software process using a software engineering approach was Humphrey (1989). Humphrey (1989:3) defines a software process as the set of tools, methods, and practices we use to produce a software product. Software engineering is the disciplined application of engineering, scientific, and mathematical principles, methods, and tools for the economical production of quality software (Humphrey 1989:248). Humphrey presents in his book Managing the Software Process the so-called Software Process Maturity Framework. This maturity framework was developed at the Software Engineering Institute (SEI) of Carnegie Mellon University. It represents the status and key problem areas of many software organizations. The framework roughly parallels the quality maturity structure defined by Crosby (1979). It addresses the six improvement steps by characterizing the software process into one of five maturity levels. By establishing their organization's position in this maturity structure, software professionals and their managers can more readily identify areas where improvement actions will be most fruitful. Before we discuss his framework the six basic principles of software process change will be presented (Humphrey 1989:19). This study assumes that those principles are also useful in the design process of EDI systems. The six basic principles are:

- Major changes to the software process must start at the top;
- Ultimately, everyone must be involved;
- Effective change requires a goal and knowledge of the current process;
- Change is continuous;

- Software process changes will no be retained without conscious effort and periodic reinforcement;
- Software process improvement requires investment.

The Software Process Maturity Framework itself represents levels. The five levels of process maturity are the initial process, the repeatable process, the defined process, the managed process and the optimizing process. The *primary objective* is to achieve a controlled and measured process as the foundation for continuing improvement. Humphrey (1989) will be followed in his description of the five maturity levels.

The Initial Process (level 1)
The initial process should be called ad hoc, as it is often chaotic. At this stage the organization typically operates without formalized procedures, cost estimates, and project plans. Organizations at the initial process stage can improve their performance by instituting basic project controls. The most important are project management, management oversight, quality assurance, and change control.

The Repeatable Process (level 2)
The repeatable process has one important strength that the initial process does not have. It provides control over the way the organization establishes its plans and commitments. The key actions required to advance from the repeatable to the next stage known as the defined process, are the establishment of a process group, the establishment of a development process architecture, and the introduction of a family of software engineering methods and technologies.

The Defined Process (level 3)
With the defined process, the organization has achieved the foundation for major and continuing progress. The foundation has now been established for examining the process and deciding how to improve it. The defined process is still only qualitative: there is little data to indicate how much is accomplished or how effective the process is. The key steps required to advance from the defined process to the next levels are: establish a minimum basic set of process measurements to identify the quality and cost parameters of each process step, establish a process database and the resources to maintain it, provide sufficient process resources to gather and maintain this process data and to advise project members on its use, and assess the relative quality of each product and inform management where quality targets are not being met.

The Managed Process (level 4)

In advancing from the initial process through the repeatable and defined processes to the managed process, software organizations should expect to make substantial software quality improvements. The greatest potential problem with the managed process is the cost of gathering data. The two fundamental requirements for advancing from the managed process to the next level are the need to support the automatic gathering of process data and the need to use process data both to analyze and to modify the process to prevent problems and improve efficiency.

The Optimizing Process (level 5)

In the optimization process, the data is available to tune the process itself. With a little experience, management will soon see that process optimization can produce major quality and productivity benefits.

Table 4.1 summarizes the basic characteristics of each process level and the actions required to graduate to the next higher level of maturity.

Table 4.1: levels of software process maturity (Humphrey 1989:56).

Levels of maturity	Characteristics	Required actions
Level 5 - Optimizing	Quantitative basis for continued capital investment in process automation and improvement	Continued emphasis on process measurement and process methods for error prevention
Level 4 - Managed	Quantitative - reasonable statistical control over product quality	Quantitative productivity plans, tracking, instrumented process environment, economically justified.
Level 3 - Defined	Qualitative - reliable costs and schedules, improving but unpredictable quality performance	Establish process measurements and quantitative quality goals, plans, measurements and tracking.
Level 2 - Repeatable	Intuitive - cost and quality highly variable, reasonable control of schedules, informal and ad hoc process methods and procedures	Develop process standards and definitions, assign process resources, establish methods (requirements, design, inspection and test)
Level 1 - Initial	Chaotic - unpredictable cost, schedule, and quality performance	Planning (size and cost estimates and schedules), performance tracking, change control. commitment management. Quality assurance

Humphrey (1989:445) divides software process improvement actions into 15 categories or indicators, which are further grouped into 4 major topics. These topics and their indicators are:

- *Organization.* This deals with management leadership of (software) organizations. This leadership is typically exercised through policies, resources allocation, management oversight, communication and training. Policies state the basic principles of organizational behaviour. The organization structure establishes basic responsibilities and allocates resources. Management oversight concerns management awareness of organizational performance. Communications deals with the means to ensure available knowledge to support timely action. Training ensures that the software professionals are aware of and capable of using the pertinent standards, procedures, methods and tools. So important indicators are policy, resources, oversight, communication, and training.

- *Project management.* This deals with the normal activities of planning, tracking, project control, and subcontracting. Planning includes the preparation of plans and the operation of the planning system. The tracking and review systems ensure that appropriate activities are tracked against plan and that the deviations are reported to management. Project control provides for control and protection of the critical elements of the software project and its process. Subcontracting concerns the means used to ensure that subcontracted resources perform in accordance with established policies, procedures, and standards. In short, important indicators are planning, tracking, project control, and subcontracting.

- *Process management.* With improving organizational maturity, a process infrastructure is established to provide uniform support and guide the project's work. This involves process definition, process execution, data gathering and analysis, and process control. The process definition provides a standardized framework for task implementation, evaluation, and improvement. Process execution defines the methods and techniques used to produce quality products. Analysis deals with measurements carried out on software products and processes and the uses made of this data. Process control concerns the establishment of mechanisms to assure the performance of the defined process and process monitoring and adjustment where improvements are needed. In short, important indicators are definition, execution, analysis, and control.

- *Technology*. This topic deals with technology insertion and environments. Technology insertion covers the means to identify and install necessary technology, while environments include the tools and facilities that support the management and execution of the defined process. In short, important indicators are technology insertion and technology environment.

Humphrey (1989) built the framework to identify maturity levels of software development in software organizations, see also Van Genuchten (1990). In this research the framework will be used to identify the level of design management. It will be used in a non-software organizational context. This framework is usable because:

- In the design process automatization departments of independent organizations work together. They are comparable with software organizations;
- The design process is taken up for a great deal by the software domain of an EDI system.

Humprey's indicators were chosen to be relevant for the level of design management. But other indicators seems to be relevant too. Therefore literature on empirical research on intra-organizational and inter-organizational information systems will be investigated.

Intra-organizational information systems
First some results will be discussed related to empirical research on intra-organizational information systems.

Lucas (1975) tries to answer the question as to why information systems fail. In his descriptive research model three indicators are central: user attitude and perceptions, use of a system and performance. He concludes that:

- Various user-oriented policies of the information systems department for systems design and operations are associated with favourable user attitudes and perceptions of systems. The technical quality of the systems is also positively related to favourable user attitudes and perceptions of information systems;
- Favourable user attitudes and perceptions and high technical systems quality are associated with high levels of use of an information system;
- Findings with regard to user performance support the classification of information into problem-finding and problem-solving categories.

Ives and Olson (1984) give an overview of research on user involvement and MIS success. They compared 22 studies on this subject. In these studies system success was measured in four different ways: system quality, system usage, perceived quality/information satisfaction, changes in user behaviour/attitudes. Eight studies show a positive relationship between user involvement and MIS success, seven studies show a positive and negative relationship, and the remaining seven studies show negative or non-significant results. Ives and Olson conclude that much of the existing research is poorly grounded in theory and methodologically flawed; as a result, the benefits of user involvement have not been convincingly demonstrated (p.586). And the common wisdom of user involvement suggests that it is appropriate for unstructured problems or when user acceptance is important (p.601).

Srinivasan and Kaiser (1987) were interested in the relationships between selected organizational factors and systems development. They focused on the available resources, external influences on the development process, and the project teams' exposure to information systems. They conducted interviews with systems managers from 28 large private firms and systems project group members completed questionnaires. The results indicate that human resources affect the development process positively, but increased financial resources are related to team disagreement. The degree of external influence on the system development effort needs to be carefully monitored and controlled. Systems exposure in the firm allows an increase in the degree of awareness among project group members about the different problems encountered by users and systems staff.

Riesewijk and Warmerdam (1988) researched success and failure factors governing automatization projects. They concentrated on the role of external automatization experts and the social-organizational aspects of automatization projects. With the help of a survey of 67 organizations and 7 case studies they concluded that project documentation, user-participation, management consultation, user-consultation and periodical reporting are important factors, see also Martens and Riesewijk (1990).

Tait and Vessey (1988) researched the effect of user involvement on system success. They report results of a field study, conducted on 42 systems, that investigated the role of user involvement and factors affecting the employment of user involvement on the success of system development. System impact and user attitudes, system complexity and resource constraints were the independent variables. The results show that high system complexity and constraints on the resources available for system development are associated with less successful systems.

Heemstra (1989) researched the estimation and control of software development costs. In a field study in the Netherlands 597 organizations filled in a questionnaire with questions concerning the estimation and control of software development. In his study Heemstra (1989:58) concluded that:

- 35% of the responding organizations did not estimate budgets for their software projects. For projects larger than 200 man months a budget was drawn up in 100% of the cases;
- 65% of the responding organizations made estimates, 62% of them based the estimates on intuition and experience;
- 50% of the responding organizations did not register any information on the project;
- 57% of the responding organizations did not calculate;
- There seems to be a difference between small and large projects with regard to the way projects exceed their budgets and delivery times. Large project exceed it in 50% of the cases. This is significantly higher than small projects;
- If a budget is prepared, in most cases the budget is not differentiated according to the different phases or activities of the project. In most cases a budget is prepared for the project only once. For organizations which focus on large projects (more than 200 man months) this is a significant difference. These organizations prepare a budget for 50% of their projects more than three times during the project. For 80% of these projects they differentiate this budget to phases and activities;
- The budget is prepared by the management and/or the project leader. In a few cases project members or the principal is involved;
- In preparing a budget they focused on the estimated spending of money, the amount of time and the number of personnel. On subjects like estimated percentage re-usability, statements on the needed capacity in terms of software and hardware were made in only a few cases;
- There are 65 organizations providing budgets based on data from finished projects but they also indicated the non-registration of data on certain projects;
- Only 16% of the budgeting organizations make use of a budget model, 75% of the users combine a budget model with an analogy method, 15% of the users combine a budget model with an expert method. Eighteen of the 51 model users did not calculate. So their budget model is validated intuitively.

Heemstra (1989) made a ranking of important factors which influence the costs, effort and lead time involved in software development. In his study no attention was paid to the quality of information systems. An analysis of these factors shows that they relate to one of the following five aspects:

- The product to be developed;
- The development staff;
- The tools;
- The project organization;
- The user.

He has developed a typology for controlling and estimating software. In the typology a distinction is made between four different control situations. Which of these applies to a specific software development situation is determined by the characteristics of the software to be developed, the process to be implemented and the resources required.

Inter-organizational information systems

Secondly, this section focuses on some recent empirical research on inter-organizational information systems. It is only in recent years that empirical research has concentrated on inter-organizational information systems (IOS). In the literature a few factors are to be found governing the success or failure of IOS design.

Van der Vlist (1987) researched telematic networks. In 5 case studies he analyzed the development of these telematic networks. He formulated 10 basic rules for the initiation and development of telematic networks. These basic rules are focused around the organization of the cooperation between participating organizations in a development project. For example, one of the rules is that the form of cooperation has to be described in detail. Only in a win-win situation will the forming of a telematic network be successful. He suggests an incremental, step-by-step approach which is centered around a pragmatic change strategy.

Benjamin et al. (1990) distinguished two critical factors with regard to the development of effective EDI applications in three case studies. The first one is the existence of industry standards and the second one is the firms's ability to manage necessary changes in the organizational structure and work processes.

In his research Wierda (1991) focused on the joint conceptualization task in developing inter-organizational information systems (IOS). With the help of four case studies, he found joint conceptualization was considered to be controversial. A main aim of joint conceptualization in an IOS effort would be to inflict the convergence of the conceptual models of the participants. He concludes that 'joint conceptual modelling has shown to be a viable approach for achieving consensus among the participants in efforts to develop inter-organizational information systems'.

Design management indicators

Design management indicators were chosen from the Humphrey framework and from the relevant literature. Each of the chosen indicators will be defined:

H1 *Level of policy*. The level of policy indicates the attention paid by top management to specifying policy starting-points. If more attention is given to policy statements, the level of design management will increase. This is one of the categories of the Software Process Maturity Framework.

H2 *Level of oversight*. The level of oversight indicates the way top management gained an overview of the design process. Management overview concerns management awareness of organizational performance. If top management gains more of an overview, the level of design management will increase. This is one of the categories of the Software Process Maturity Framework.

H3 *Level of resources*. The level of resources indicates the attention given to resources involved in the design process. If more attention is given to resources, the level of design management increases. This is one of the categories of the Software Process Maturity Framework.

H4 *Level of human resources constraints*. The level of human resources constraints indicates the attention given to human resources constraints during the design process. If more attention is paid to human resources constraints, the level of design management increases. This indicator was derived from Srinivasan and Kaiser (1987), Tait and Vessey (1988) and Raymond (1990).

H5 *Level of experience*. The level of experience indicates the experience or knowledge was available on EDI during the design process. If there is more experience available, the level of design management increases. For example Beers (1991) focused on the availability of knowledge.

H6 *Level of representation of actors*. The level of representation of actors indicates the way the organizations were represented in the design process. If the organization is well represented there, the level of design management increases.

H7 *Level of communication*. The level of communication indicates the way designers and end-users communicated. If more attention is given to communication, the level of design management increases. This is one of the categories of the Software Process Maturity Framework.

H8 *Level of training*. The level of training indicates that the software professionals are aware and capable of using pertinent standards, procedures, methods, and tools. If training is more specified, the level of design management increases. This is one of the categories of the Software Process Maturity Framework.

H9 *Level of planning*. The level of planning indicates the attention which was given to planning (the preparation of plans and the operation of the planning system). If more attention is given to planning, the level of design management increases. This is one of the categories of the Software Process Maturity Framework.

H10 *Level of tracking*. The level of tracking indicates the way the design process was tracked, for example, by review systems which ensure that appropriate activities are tracked against plan and that deviations are reported to management. If more attention is given to tracking, the level of design management increases. This is one of the categories of the Software Process Maturity Framework.

H11 *Level of project control*. The level of project control indicates the attention given to control and protection of critical elements of the project and its process. If there is more emphasis on project control, the level of design management increases. This is one of the combined categories of the Software Process Maturity Framework.

H12 *Level of subcontracting*. The level of subcontracting indicates the means used to ensure that subcontracted resources perform in accordance with established policies, procedures and standards. If the subcontracting is more specified, the level of design management increases. This is one of the categories of the Software Process Maturity Framework.

H13 *Level of connection on internal decision-making*. The level of connection between intra-organizational and inter-organizational decision-making indicates the tuning between those decision-making processes. If there is more tuning, the level of design management increases.

H14 *Level of definition*. The level of process definition indicates whether a standardized framework for task implementation, evaluation, and improvement is in existence. If the process is more defined, the level of design management increases. This is one of the categories of the Software Process Maturity Framework.

H15 *Level of execution*. The level of process execution indicates the methods and techniques used to produce quality products. If those methods and techniques are implemented more often, the level of design management increases. This is one of the combined categories of the Software Process Maturity Framework.

H16 *Level of analysis*. The level of analysis indicates the attention paid to the analysis of the design process in terms of used resources, costs, and realized quality. If more attention is given to analysis, the level of design management increases. This is one of the categories of the Software Process Maturity Framework.

H17 *Level of control*. The level of process control indicates the establishment of mechanisms to assure the performance of the defined process and process monitoring and adjustment where improvements are needed. If more attention is given to control, the level of design management increases. This is one of the categories of the Software Process Maturity Framework.

H18 *Level of technology insertion*. The level of technology insertion indicates the means to identify and install the necessary technology. The more technology inserted the higher the level of design management. This is one of the categories of the Software Process Maturity Framework.

H19 *Level of technology environment*. The level of technology environment indicates the tools and facilities that support the management and execution of the defined process. If the technology environment is specified, the level of design management increases. This is one of the categories of the Software Process Maturity Framework.

The conceptual model also focuses on operational management referring to the five domains of an EDI system: technical, software, data, users, and organizational. These domains were discussed in chapter 2. Technical architecture deals with the technical domain. Standard software design deals with the software domain. Datamodelling design and message standardization design are related to the data domain of EDI. User involvement deals with the user domain. Organizational design deals with the organizational or procedural domain. The indicators are:

H20 *Degree of interest in technical architecture design*. The degree of interest in technical architecture design indicates the use of a common, simple and transparent technical architecture. It is related to the technical domain of EDI systems. If more interest is shown in technical architecture design, the level of design management improves. Lucas (1975), Tait and Vessey (1988) and Hice (1991) raised this item.

H21 *Degree of interest in datamodelling design*. The degree of interest shown in datamodelling design indicates an interest in modelling the data interchange between organizations by achieving consensus among the participants in the design group using data-modelling techniques. It is related with the data domain of EDI systems. If more interest is shown in data modelling, the level of design management increases. This item was mentioned by Hofman (1989), Van Heck et al. (1991) and Wierda (1991).

H22 *Level of use of message standardization.* For national and international data interchange it seems to be relevant to structure messages with the help of international standards like EDIFACT (ISO 1988) and Ediforum (1990:223). Hice (1991) argues that the organization must adopt a complete set of standards, which should be of the 'open system' variety, such as those publicized by the International Standards Organization (ISO), so that a wide range of hardware and software choices are available for implementation. If more message standardization is used, the level of design management increases. This indicator is related to the data domain of EDI.

H23 *Level of use of standard EDI software.* With the help of standard application software it is possible to implement EDI. There are several standard software applications, see Ediforum (1990:131). If more standard EDI software is used, the level of design management increases. This indicator deals with the software domain of EDI.

H24 *Level of user involvement.* The level of user involvement indicates the intensiveness with which users were involved in the design process. For example, Ives and Olson (1984) concentrated on this item. Baroudi et al. (1986) concluded that: 'In total, the careful construction of this study permits the tentative conclusion that user involvement in system development leads to increased user information satisfaction and increased system usage'. If users are more involved, the level of design management increases. This indicator deals with the user domain of EDI systems.

H25 *Level of attention to organizational design.* System development activities tend to overlook the fact that organizational roles, job content, autonomy, work loads, and so on, can be radically affected by changes in the other EDI domains, see for example Lyytinen and Hirschheim (1987:278). If more attention is given to organizational aspects within the design, the level of design management increases. This indicator is relevant to the organizational domain of EDI systems.

4.8 EDI system-design success

In this section EDI system-design success will be refined. EDI system-design success will be considered from a project-auditing point of view. A project audit is a formal and systematic examination of the performance of an ongoing project as compared to its requirements (Turner 1990:16). To this end, the project auditor investigates the underlying records, the tangible results of work done, the project management, the project methodology and techniques, and the organization and controls. This enables the project auditor to report a firm opinion regarding the five principle objectives of each project audit (Turner 1990:16). These five principle objectives are:

(1) The current status of the project at the time of the project audit as compared to the contractor's and customer's contractual obligations and management expectations;
(2) The forecast status of the audited project at various future times as compared to the contractor's and customer's contractual obligations and management expectations;
(3) The critical management issues that may have a negative effect on the fulfilment of the contractor's and customer's contractual obligations and management expectations;
(4) The exposure to risks and potential for losses arising from the nature of the project and the contract for both the customer and contractor;
(5) The lessons which can be usefully applied to other projects within the organization.

There are many ways of viewing the success or failure of an EDI system design. Lyytinen and Hirschheim (1987) identify four major categories of definitions of failure in the literature related to information systems (IS). These four major categories are:

(1) *Correspondence failure*. Correspondence failure is the most popular notion of IS failure, and typically expresses management's view of IS failure. Its main premise is that design objectives are stated in advance, and if these are not met, the IS is a failure. Lyytinen and Hirschheim (1987) consider that:
    - There have been ISs which met their objectives, but when viewed globally they could hardly be construed as successful.
    - Many researchers have pointed out that management objectives are ambiguous, only expressing broad hypotheses for action. For this reason objectives tend to be fragmentary, conflicting, and their interpretation is context-driven. Objectives can also be ambiguous due to the low quality of, and bias in, requirements specification or due to conflicts in management perception and associated bargaining. In many cases it is difficult, if not impossible, to observe any correspondence objectively.
    - Even it were possible to represent management objectives accurately, the difficulties in accurate measurement of IS performance are far from trivial.

In fact, the problems involved in verifying and validating measurement instruments are immense.

(2) *Process failure*. In many situations when the IS cannot be produced within given budget constraints, it results in what is called a 'process failure'. The concept of process failure captures two related but distinct aspects of unsatisfactory performance in producing the IS. First, if the IS development process cannot produce any workable system, it is without doubt a failure. Usually this would involve unresolvable problems in designing, implementing, or configuring the IS. Second, and the more common aspect of process failure, is when the process produces an IS, but one which involves vast amounts of overspending both in cost and time, thus limiting or negating the global benefits of the system.

(3) *Interaction failure*. Because of the problems in measuring IS objectives, some researchers have suggested that a low level of IS use can be used as surrogate for IS failure. Some related measures are user attitudes and user satisfaction. Primary attention is given to users' interactions with the system, this failure concept is termed 'interaction failure'.

(4) *Expectation failure*. In this category an information system failure is defined as the 'inability of an IS to meet a specific stakeholder group's expectations'. It stresses the importance of understanding how various stakeholders perceive and comment on the value of the IS: failure is the embodiment of a perceived situation.

A combination of correspondence, process and expectation failure is worked out by Turner (1990:36). He argues that there are different viewpoints on minimum requirements to the positions of the various parties involved with the project. Important requirements are contract minimum requirements (CMR), user minimum requirements (UMR), contractor minimum requirements (COMR), project manager minimum requirements (PMMR), technician minimum requirements (TMR) and legal minimum requirements (LMR). The main viewpoints on minimum requirements are those of the contract (CMR), the user needs (UNMR), and the contractor (COMR). Turner (1990:38) compared these viewpoints and stated that:

. If the contract's minimum requirements are exceeded, the usual result is that the results are satisfactory. The exceptions are when the contract does not meet the minimum requirements in terms of user-needs in a material way because these were not properly included in the contract. The contractor may have wanted the product to exceed the CMR because it was to be used for other purposes.

- If the contract's minimum requirements are met, the normal result is that all parties are satisfied. However, the same conditions apply as did in the case where the contract's minimum requirements were exceeded. As just meeting the CMR does not leave much room for error, it is more probable that the user-needs or contractor-expectations will not be fully met.
- If the contract's minimum requirements are not met then there is a high probability that the minimum requirements in terms of user's needs and contractor-expectations have not been met. In rare cases, this will not be the case when the contract included user-wants that were not really user-needs and this was later realized by the user.

Three dimensions of design success can be identified from the contribution of Project Auditing and the view of contract minimum requirements (CMR). These three dimensions are the quality of the product, the cost of its development, and the delivery time (Turner 1990:38). This study specifies these dimensions in the quality of the EDI system design, the cost of its design and the delivery time of its design. Along these dimensions the actual outcome will be compared with the planned or budgeted outcome. The planned outcome can be specified in the cooperation contract as the output of the contracting process. Each of the dimensions will be discussed.

Quality dimension of EDI system design

The quality dimension was discussed in detail in chapter 2. There, a report was given of how Delen and Rijsenbrij (1990a and 1990b) formulated a consistent overview of quality attributes related to different stakeholder groups. They specify the product quality of information systems. They distinguish dynamic quality attributes of information systems (for the user) and static quality attributes of information systems (for the developer and administrator of systems). Dynamic attributes are reliability, continuity, efficiency, and effectivity. Static attributes are flexibility, maintainability, testability, portability, connectivity, re-usability and suitability of infrastructure. The quality of the EDI system design will be defined as the ratio between the planned versus the realized dynamic and static quality attributes of the EDI system design.

Costs dimension of EDI system design

The costs of the EDI system design can be specified, for example, into the cost of personnel resources, cost of administration resources, cost of travelling, cost of housing.

The planned costs of the EDI system design will be defined as the costs needed to fulfil the EDI design process as specified in the cooperation contract. The realized costs of the EDI system design will be defined as the actual costs needed to fulfil the EDI design process.

Time dimension of EDI system design

The planned delivery time of the EDI system design is defined as the planned delivery time of the EDI system design as specified in the cooperation contract. The realized delivery time of the EDI system design is defined as the actual delivery time of the EDI system design.

EDI system-design success

Indicators for EDI system-design success are:

- Planned versus realized dynamic and static quality attributes of the EDI system design;
- Planned versus realized costs of the EDI system design;
- Planned versus realized delivery time of the EDI system design.

Besides the indicators showing the three dimensions of contract minimum requirements (CMR), the project manager minimum requirements (PMMR) were also estimated. These requirements are subjective. The project manager has to indicate the level of success of the contract and the level of success of the EDI system design.

4.9 Hypotheses

The constructs of the general research model are refined into variables. The propositions of the general research model are refined into hypotheses. The variables and hypotheses form the specific research model, which is presented in figure 4.2. Eight hypotheses are presented for the relationships between the variables in the specific research model. The hypotheses will be tested in this study. In table 4.2 the independent and dependent variables of the hypotheses are presented.

In statement form, the hypotheses are formulated as follows, see also table 4.2:

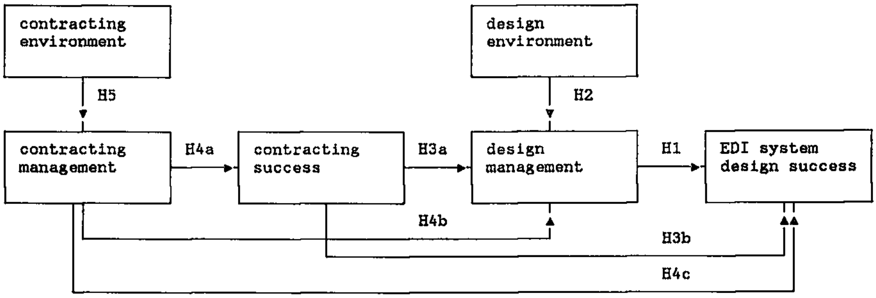


Figure 4.2: specific research model and hypotheses (for H3b, H4b and H4c only direct relationships are shown).

H1: As the level of design management increases, the level of EDI system-design success increases.

H2: As the level of stability of the design environment increases, the level of design management increases.

H3a: As the level of contracting success increases, the level of design management increases.

H3b: As the level of contracting success increases, the level of design management and the level of EDI system-design success increases.

H4a: As the level of contracting management increases, the level of contracting success increases.

H4b: As the level of contracting management increases, the level of contracting success and the level of design management increases.

H4c: As the level of contracting management increases, the level of contracting success and the level of design management and the level of EDI system-design success increases.

H5: As the level of cooperativeness of the contracting environment increases, the level of contracting management increases.

Table 4.2: hypotheses tested in this study.

Independent variable(s)	Dependent variable	Hypothesis	Direction
design management	EDI system-design success	H1	+
design environment	design management	H2	+
contracting success	design management	H3a	+
contracting success & design management	EDI system-design success	H3b	+
contracting management	contracting success	H4a	+
contracting management & contracting success	design management	H4b	+
contracting management & contracting success & design management	EDI system-design success	H4c	+
contracting environment	contracting management	H5	+

In part 2 of this study these hypotheses will be tested.

4.10 Summary

The following questions were answered in this chapter:

. What are relevant constructs derived from the lessons learned from the Decision-making and Environmental school related to the problem stated?

- Arguments were given for choosing the constructs: contracting environment, contracting management, contracting success, design environment, design management, EDI system-design success.

. What are relevant propositions in that respect?

- Two propositions are relevant and will be investigated:
  Proposition 1: Contracting success is affected by contracting management and its contracting environment.

Proposition 2: EDI system-design success is affected by design management, its design environment and contracting success.

. What are relevant variables in the research model?

- Relevant variables of each of the constructs were specified. Variables were refined into indicators.

The construct *contracting environment* is further refined into level of cooperativeness of the contracting environment e.g. the sector related to the EDI project. The indicators are level of competition between organizations, stage of growth cycle, stage of product/market cycle, level of bargaining power between organizations, level of organization with regard to EDI in the sector.

The construct *contracting management* is further refined into level of contracting management. The indicators are: level of strategic planning, level of costs/benefits of EDI, level of demonstrable benefits, level of partner choice, level of human resources, level of mutual trust, level of planning.

The construct *contracting success* is further refined into the variable specification of the cooperation contract. Indicators are specified contract aspects.

The construct *design environment* is further refined into level of stability of the design environment e.g. the organizations cooperating in the EDI project. The indicators are: level of automatization, level of difference in automatization, level of organizational changes, level of organization size, level of status uncertainty.

The construct *design management* is further refined into level of design management. There are twenty-five indicators distinguished ranging from level of policy to level of organizational design.

The construct *EDI system-design success* is further refined into three dimensions: quality, costs, time. The indicators are: planned versus realized quality, planned versus realized costs and planned versus realized delivery time of the EDI system design.

- What are relevant hypotheses in the research model?

- Eight hypotheses are formulated expressing the relations between the distinguished variables. In part II of this study those hypotheses will be tested.

PART II THEORY TESTING

'Few propositions of science are directly verifiable as true. In fact, none of the important ones are. For the most part they concern unobservable entities, such as molecules and atoms, electrons and protons, chromosomes and genes.'

- Irving Copi, *Introduction to Logic* -

'Since all motion is relative, you may take any body you like as your standard body of reference, and estimate all other motions with reference to that one.'

- Bertrand Russell, *The ABC of Relativity* -

5 SURVEY RESEARCH INTO EDI PROJECTS

5.1 Introduction

An old English proverb says that the proof of the pudding is in the eating. Therefore the specific research model will be put to the stringent test of empiricalness. In this part the research model, built in part I, will be tested. Weill and Olson (1989) suggest that in the field of information systems research, a wider selection of methodologies should be used, including qualitative case studies, ethnographic studies, longitudinal studies and a combination of qualitative and quantitative measures in the same study. In this study a combination of qualitative and quantitative measures was used. Chapters 5 and 6 deal with the quantitative approach viz. survey research. Chapters 7 and 8 deal with the qualitative approach viz. case study. This chapter tries to answer the following questions:

- How can the research model be measured in a quantitative way?
- What is the quality of the measuring-instrument?
- How can the data be analyzed with the help of which data analysis method?
- Are the data suitable for those data analysis methods?

In section 5.2 the research approach and material will be described. EDI project managers of 35 Dutch EDI projects were interviewed in a structured interview setting using a questionnaire. In section 5.3 the measurement of the model variables will be discussed. In section 5.4 the quality of the questionnaire as measuring instrument in terms of validity and reliability will be investigated. In section 5.5 the multi-variate analysis methods used as methods of data analysis will be described.

5.2 Research approach and material

Galliers (1990) argues that the survey, descriptive/interpretive and action research approaches appear to have the widest applicability in information systems' research. In Galliers revised taxonomy the traditional approaches like case study, survey, simulation and game/role playing and also the newer, interpretivist approaches like descriptive/interpretive and action research are relevant for theory testing. For theory testing, a quantitative scientific approach was chosen, the survey research, and a qualitative scientific approach, the case study. The qualitative approach will be discussed in chapter 7.

Survey
In the survey the hypotheses, described in chapter 4, will be tested using a questionnaire in a structured interview setting. The questionnaire is described in more detail in section 5.3. This research study follows that used in the majority of previous studies on intra-organizational information systems (Alter 1978; Edstrom 1977; Olson and Ives 1981; Tait and Vessey 1988). If carefully designed, surveys are a good means of looking at a great number of variables and they can provide a reasonably accurate description of real world situations (Galliers 1990). Given large sample sizes, there could be an argument for (statistical) generalization. Galliers (1990:162) warns that: 'Surveys are essential 'snapshots' of practices, situations or views at a particular point in time..'...'However, little insight is usually gained regarding the causes or the processes behind the phenomena under study'. In, addition, there remains the likelihood of bias on the part of the respondents (especially those filling in the questionnaires, for example because they are self-selecting), on the part of the researcher, and in relation to the moment in time when the research is undertaken (Galliers 1990). The specific research model of this study will give insight into the causes behind the phenomena or the processes behind the phenomena. In addition to the bias problems this study opted for a survey in a structured interview setting. Strengths of a structured interview setting are that (1) more difficult questions had to be answered by the project manager, (2) the answers can be checked by open questions, (3) interpretation problems posed by the questions can be reduced.

EDI projects
The sample consisted of 35 Dutch EDI projects. First, 50 EDI projects were selected from 91 EDI projects, as was taken stock by Ediforum (1991). The following sectors were related to the selected projects : agriculture, industry, construction, trade,

transport/storage, banking/insurance, healthcare, government, and others. The selection criterium was that the EDI project should recently have finished the design process.

EDI project managers

It was decided that project managers of EDI projects should be interviewed. The following arguments were used to chose project managers of EDI projects as main information sources:

- Project managers can indicate the level of outcome of the design process of the EDI system design in terms of quality, costs and delivery time;
- Project managers can indicate the level of outcome of the contracting process in terms of the level of specification of the cooperation contract;
- Project managers can indicate the level of cooperativeness of the contracting environment, the level of contracting management, the level of stability of design environment and the level of design management;
- Project managers of different EDI projects are comparable in the sense that their positions in terms of function and activities are more or less equal.

The weakness of this approach lies in the bias of project managers. The results of the EDI project are related to a high degree to the position and status of the project manager. Therefore the choice was made to design an objective measuring instrument of contracting success and EDI system-design success, and to accurately specify each level of contracting environment, contracting management, design environment and design management. It was assumed that the bias of the project managers worked for all EDI projects in the same direction and that the relative value of the model variables of the EDI projects was important.

Names and addresses of EDI project managers were obtained from Ediforum (1991). The project managers of these projects were sent a letter about the research project. Then they were contacted by phone and asked to collaborate with the research. If they were willing to collaborate an appointment was made and a structured interview was held. Finally, 36 appointments for interviews were made, of which 35 interview results proved appropriate. An analysis of response and non-response is given in section 6.2. The interviews lasted for between one- and-a-half and two hours. The interviews were done by a research-assistant or the researcher. Both were experienced in taking interviews. After each interview the research-assistant and the researcher discussed the results. Interviews were held in the period December 1991 - February 1992. Project managers kept a copy of the questionnaire to compare their results with the final results of this study. In this study the results of the projects were described anonymously.

5.3 Measurement of the model variables

This section discusses the scales used in this questionnaire and the way in which the model variables are measured will be explained.

In measurement, five different types of scales are considered; a nominal, ordinal, interval, ratio and absolute scale (Churchill 1987). A person's social security number is a nominal scale, as are the numbers on football jersies, lockers, and so on. An ordinal scale not only implies identity but also order. An example would be the assignment of the number '1' to denote primary school children and '2' to denote secondary school children. Measurement with an interval scale implies that the differences between the intervals can be compared. One classic example of an interval scale is the temperature scale. The ratio scale differs from an interval scale in that it possesses a natural or absolute zero, one for which there is universal agreement in terms of location. Height and weight are obvious examples. With a ratio scale it is possible to say that 'Eric weighs twice as much as Marc'. The number of units can be identified with the absolute scale; the amount of unemployment, the amount of children in a family, and so on. In this research project, hypotheses are investigated using regression analysis. Therefore the model variables are at least to be measured on an interval scale.

In the questionnaire the data are gathered by using ordinal scales, interval scales and open questions. For each of the aspects of the model variables measured by the ordinal scale, five levels are defined. The numbers used in the ordinal scale are ordered from 1 to 5; the higher the number, the higher the level. Each model variable had to be expressed in one number. Therefore the scores of all the aspects belonging to the model variable were added up. Implicit in this method, is the assumption that the differences between the levels are in some sense equal. The result of the addition can therefore be considered as a variable on an interval scale. In a case like this, Swanborn (1981) talks about an interval or a quasi-interval scale. These values, representing the model variables, can be used in regression analysis. The measurement of the subjective contracting success and EDI system-design success was done by using a five point Likert scale.

Questionnaire

The following subsections describe the questionnaire. The questionnaire was divided into eleven sections each question indicated by a letter and a number, see appendix 1. The first section (section B), deals with the general characteristics of the EDI project, section C deals with contracting management, section D deals with contracting environment, section E deals with contracting success, section F deals with EDI system design within the cooperation contract, section G deals with situations where there was no cooperation contract, section H deals with design management, section I deals with design environment, section J deals with EDI system-design success. The last section, section K, deals with EDI system-implementation success. This variable was measured although it was not in the research model. This variable and its results will be discussed in section 6.6. Questions concerning implementation success could be filled in by the project manager if the EDI system had already been implemented.

Firstly, the general characteristics of the EDI project will be discussed. Secondly, the questions dealing with the contracting environment will be discussed. Successively, questions concerning contracting management, contracting success, design environment, design management, and EDI system-design success will be discussed.

General characteristics

The questionnaire started off with a section dealing with some general characteristics of the EDI project. Questions were related to the size of the project, the related sector, the number of organizations involved, the current process the project was in, how many messages were designed, what sort of communication form was developed, the strategic objectives, and when the first contact between the participants had taken place. Also questions concerning the function of the respondent and their performed activities were asked. The purpose of those questions was:

- To build a relationship of trust between interviewer and the project manager interviewed;
- To determine if the project really was an EDI project;
- To determine if the project really finished the design process;
- To determine if the respondent was the project manager and performed project management activities.

Contracting Environment

The questions related to level of cooperativeness of the contracting environment are indicated in the questionnaire with D1 - D5 (see appendix 1). For each of these questions the EDI project manager was asked to rate the level of the item on an ordinal scale with five possibilities presented in mounting order. For each indicator five possible levels were specified. The scores of all the indicators were added up and this addition represents the cooperation level of the contracting environment and will be used in the analysis methods. The domain of the level is between 1 (low cooperative) and 5 (high cooperative).

Contracting Management

The questions related to the level of contracting management are indicated in the questionnaire with C1 - C7 (see appendix 1). The EDI project manager was requested to rate the level of the contracting management on an ordinal scale offering five possibilities. For each indicator the answer possibilities were specified in mounting order. The scores of all the indicators were added up. This score represents the level of the contracting management and will be used in the analysis methods. The domain of the level is between 1 (low level) and 5 (high level).

Contracting Success

The question related to contracting success is numbered in the questionnaire as E4 (see appendix 1). The contracting success is defined as the level of specification of the cooperation contract. Therefore the project manager is asked which attributes of the cooperation contract are specified. The domain of the level is between 0 (low specification) and 1 (high specification). The operational formula to measure the contracting success is:

$$(1) \quad CS = \frac{A_{cs}}{A_{cp}}$$

CS = Contracting Success;
A_{cs} = Specified contract Attributes;
A_{cp} = Possible contract Attributes.

The subjective contracting success was measured too. The project manager was asked to rate the contracting success on a five point likert scale (see question L1 of the questionnaire).

(2) $CS_u = V_c$

CS_u = Subjective Contracting Success;
V_c = Subjective Contracting Success Value.

Design Environment
The questions related to the level of stability of the design environment are numbered in the questionnaire from I1 - I5 (see appendix 1). For each of these questions, the EDI project manager was asked to rate the stability level of the design environment on an ordinal scale choosing between five possibilities presented in mounting order. Indicator I4 was presented in descending order. Just like before, the scores for all indicators were added up and the addition represents the stability level of the design environment and will be used in the analysis methods. The domain of the level is between 1 (low stability) and 5 (high stability).

Design Management
The questions related to the level of design management are numbered in the questionnaire from H1 - H25 (see appendix 1). For each item, the EDI project manager was requested to rate the level of the design management on an ordinal scale choosing from five possibilities presented in mounting order. The scores of all the indicators were added up. This score represents the level of the design management and will be used in the analysis methods. The domain of the level is between 1 (low level) and 5 (high level).

EDI system-design success
EDI system-design success was defined by the way the planned EDI system design dimensions were realized. The success consisted of three dimensions: quality (Q), costs (C) and delivery time (T). The questions related to these three dimensions are numbered in the questionnaire as J2, J3, J5, J6, J7, J9, J10, J11 and J12 (see appendix 1). The relative importance of each dimension is defined as follows. First, the specific relative importance was defined by the project managers as can be seen in question J14. They were asked to define the relative importance of each dimension for the EDI system design by dividing 100 points over the three dimensions. Then the average relative

importance is defined, which is determined by taking the average over the investigated EDI project managers. This lead to the average EDI system design quality factor, the average EDI system design costs factor and the average EDI system design time factor. The domain of EDI system-design success is between 0 (not successful) and 1 (successful). The formula is:

(3) $EDS = (Q_{ds} * F_{daq}) + (C_{ds} * F_{dac}) + (T_{ds} * F_{dat})$

EDS = EDI system-design success;
Q_{ds} = Quality dimension EDI system-design success;
C_{ds} = Cost dimension EDI system-design success;
T_{ds} = Time dimension EDI system-design success;
F_{daq} = Average EDI system design quality Factor;
F_{dac} = Average EDI system design costs Factor;
F_{dat} = Average EDI system design time Factor.

(4) $F_{daq} + F_{dac} + F_{dat} = 1$

F_{daq} = Average EDI system design quality Factor;
F_{dac} = Average EDI system design costs Factor;
F_{dat} = Average EDI system design time Factor.

The subjective EDI system-design success was also measured. The project manager was asked to rate the EDI system-design success on a five point Likert scale, see question L2 of the questionnaire.

(5) $EDS_u = V_d$

EDS_u = Subjective EDI system-design success;
V_d = Subjective design success Value.

The domain of the formula measuring the quality dimension of the EDI system-design success is between 0 (lower realized quality than planned) and 1 (equal realized quality to that planned). Project managers could indicate which quality of the EDI system design was completely or incompletely realized in that design (see questions J2 and J3). This study follows Alexander (1967) by identifying the state of each potential misfit between planned and realized quality attribute by means of a binary variable. The formulas are:

(6) $$Q_{ds} = \frac{A_{dr}}{A_{dt}}$$

Q_{ds} = Quality dimension EDI system-design success;
A_{dt} = Total EDI system design quality Attributes;
A_{dr} = Realized EDI system design quality Attributes.

The domain of the formula to measure the costs dimension of the EDI system-design success is between 0 (more realized costs than planned) and 1 (equal realized costs to those planned). Project managers could indicate the planned and realized total costs of the EDI system design and where budget had been exceeded (see question J7). The formulas are:

(7) If $C_{dr} \leq C_{dp}$

$$C_{ds} = 1.00;$$

(8) If $C_{dr} > C_{dp}$ and $C_{dr} \leq 1.1 * C_{dp}$

$$C_{ds} = 0.75;$$

(9) If $C_{dr} > C_{dp}$ and $C_{dr} > 1.1 * C_{dp}$ and $C_{dr} \leq 1.5 * C_{dp}$

$$C_{ds} = 0.50;$$

(10) If $C_{dr} > C_{dp}$ and $C_{dr} > 1.5 * C_{dp}$ and $C_{dr} \leq 2.0 * C_{dp}$

$$C_{ds} = 0.25;$$

(11) If $C_{dr} > C_{dp}$ and $C_{dr} > 2.0 * C_{dp}$

$$C_{ds} = 0.00;$$

C_{ds} = Cost dimension EDI system-design success;
C_{dp} = Planned EDI system design Costs in guilders;
C_{dr} = Realized EDI system design Costs in guilders.

The domain of the formula to measure the time dimension of the EDI system-design success is between 0 (more realized time than planned) and 1 (equal to the time planned). The project managers could indicate the starting date, the planned delivery date, the realized delivery date and the excess time (see question J12). The formulas are:

(12) If $T_{dr} \leq T_{dp}$

$T_{ds} = 1.00;$

(13) If $T_{dr} > T_{dp}$ and $T_{dr} \leq 1.1 * T_{dp}$

$T_{ds} = 0.75;$

(14) If $T_{dr} > T_{dp}$ and $T_{dr} > 1.1 * T_{dp}$ and $T_{dr} \leq 1.5 * T_{dp}$

$T_{ds} = 0.50;$

(15) If $T_{dr} > T_{dp}$ and $T_{dr} > 1.5 * T_{dp}$ and $T_{dr} \leq 2.0 * T_{dp}$

$T_{ds} = 0.25;$

(16) If $T_{dr} > T_{dp}$ and $T_{dr} > 2.0 * T_{dp}$

$T_{ds} = 0.00;$

T_{ds} = Time dimension EDI system-design success;
T_{dp} = Planned EDI system design Time in man months;
T_{dr} = Realized EDI system design Time in man months.

5.4 Quality of the measuring-instrument

In the measurement of model variables, the quality of the measuring-instrument plays an important role. The quality of a measuring-instrument is defined by the validity and reliability (Swanborn 1981). These two dimensions will be discussed.

Validity of the measuring-instrument

Validity is the way in which the measuring-instrument measures the variable to be measured. One has to distinguish between content validity, criterium validity and construct validity (Janssens 1983; Segers 1983; Meerling 1984). Content validity says something about the way in which the chosen indicators reflect the variable to be measured (Janssens 1983). Criterium validity is about the relationship between the scores measured with the measuring-instrument and the scores which can be expected on the basis of other observations. The third type of validity, construct validity, tests whether an expected relationship between the variable to be measured and another variable occurs in reality.

Content validity
First, the content validity of the questionnaire was looked at by the researcher and his promoters. The questionnaire was tested out at one EDI project. The project manager of that EDI project filled in the questionnaire in cooperation with the researcher. The project manager discussed the questionnaire in terms of the clarity and comprehensibility of the questionnaire and practical issues like how to approach project managers.

Criterium validity
Criterium validity covers the relationship between the scores measured with the measuring-instrument and the scores which can be expected on the basis of other observations. The project managers of six EDI projects were asked to fill in the questionnaire. This questionnaire was the version 1 questionnaire and the same questionnaire which was filled in by the project manager during the content validity survey. These six projects were chosen from a group of 26 so-called VEDI (Example EDI) projects. These VEDI projects are subsidized by the Dutch Ministry of Economic Affairs. The six EDI projects were chosen for the criterium validity because:

- These projects are VEDI projects so the contracting success and EDI system-design success could be measured due to the fact that these projects were obliged to have a project plan (a sort of contract) and were obliged to finish the design process in order to obtain their subsidy from the Ministry;
- A project leader from the VEDI program who knew the different VEDI projects was available and agreed to contribute to the criterium validity. As an expert he was asked to estimate the different variables used in the projects;
- The six projects were chosen for their underlying difference in project size, project type, related sector, and a first assessment of the results of the project by the researcher.

In order to obtain an external assessment of the different variables of these six EDI projects, a project leader of the VEDI program was asked, as an expert, to indicate the ranking of the project and to give an explanation of the ranking and an estimated score for the project variables. The variables were contracting environment, contracting management, contracting success, design environment, design management, EDI system-design success. To measure the level of each variable a special questionnaire was put together. The questionnaire was filled in by the expert in collaboration with the researcher. During the session the expert was given an impression of the six projects.

Although six project managers agreed to cooperate in establishing the criterium validity, in the end, two project managers were not willing to fill in the questionnaire. One project manager could not get permission from the top-management of his organization. The second project manager was too busy and could not find the time to fill in the questionnaire. So four questionnaires were received on the criterium validity.

First the experts' view on the four projects will be presented then the results of method 1 (measurement by an expert) and method 2 (measurement by questionnaire) for the four projects will be discussed.

Impression of the four projects
The expert was given the following impression of the four EDI projects. The projects are referred to anonymously as A, B, C, and D.

Project A
Project A deals with electronic invoices between one particular supplier and one particular buyer. It is a simple project and averagely successful. The problem lies in the

environment and involves the legal and fiscal aspects of EDI viz. the legal and fiscal status of the EDI invoice message. The treasury in the Netherlands would not recognize electronic invoices, therefore the participants in the project still had to send the invoice on paper.

Project B

This project deals with one particular supplier and one particular buyer. The project is recognized to be a failure. There was barely a project plan or cooperation contract. The buyer forced the supplier to cooperate in the EDI project. The EDI system design was a failure and a restart of the project has been announced. The quality of the EDI system design was very poor.

Project C

This project deals with invoices between suppliers and buyers and an intermediate central buying organization. The problem in this project lies in the environment (like project B) and deals with the legal and fiscal aspects of EDI viz. the legal and fiscal status of the EDI invoice message.

Project D

This project deals with the order-forms and confirmations of orders between suppliers and a buyer. The project manager operates in a cautious way. The results seems to be satisfactory.

Results of the estimations

After receiving and processing the questionnaires from the project managers and the expert, the following results could be calculated. Method 1 deals with measurement by the questionnaire. Method 2 deals with measurement by the expert. The measurements are calculated on a scale of 0 - 100. The following variables were discussed: contracting environment, contracting management, contracting success, design environment, design management, EDI system-design success. In table 5.1 the results are presented.

Table 5.1: comparison of the results of Method 1 (M1: measurement by questionnaire) and Method 2 (M2: measurement by the expert) for six variables on four projects.

Measured variables	Project A M1	Project A M2	Project B M1	Project B M2	Project C M1	Project C M2	Project D M1	Project D M2
contracting environment	50	60	25	80	25	80	40	80
contracting management	45	60	40	0	40	70	45	60
contracting success	30	50*	30	10	50	50*	0	50*
design environment	40	10	40	70	50	20	50	80
design management	45	45*	40	0	35	45*	50	45*
EDI system-design success	0	70	0	0	45	70	0	70

* The expert results are not given explicitly. instead they have given an approximation as the average between the lowest and highest value of the variable.

The following conclusions can be derived from the comparison of the two measurement methods. The conclusions are merely indicative because only four cases were investigated for the criterium validity.

Contracting Environment

Method 1 and method 2 gave similar results although there is a level difference between the outcome using method 1 and using method 2. In project A there is a difference. Method 1 gave a higher number compared with the other projects for the contracting environment of project A. While method 2 gave lower figures compared to the other projects.

Contracting Management

Method 1 and method 2 gave similar results. Only in project B is there a difference to be seen. Here method 2 is given a lower score. The explanation for this could be that the expert was focused on the outcome and not on the management of the contracting activities. The outcome of the contracting process of project B, as measured by the expert, was 10.

Contracting Success

Method 1 differentiates more than method 2. With regard to the contracting success of project D, method 2 measures 50 and Method 1 measures 0. An explanation of the difference could be that in method 1 the level of success is related to the level of specification of the cooperation contract. In project D no cooperation contract was specified. So the expert was using different indicators for contracting success.

Design Environment

Method 1 did not show much variation between the environment of the design process for the different projects. Method 2 differentiated the environment of the design process more. An explanation for the difference between the outcomes could be that the expert is using different indicators and more of them. An indication of this is the explanation the expert gave with the outcome. He focused on the existing design and standards and the legal and fiscal status of the EDI messages in the environment.

Design Management

Method 1 and method 2 gave similar results. Only in project B is there a difference. Here method 2 is given a lower result. The explanation for this could be that the expert was focused on the outcome and not on the management of the design activities. The outcome of the design process of project B, as measured by the expert, was 0.

EDI system-design success

Method 1 gives a score 0 for the design success of the projects A, B and D. The explanation for this is that the planned versus realized situation is compared. In these projects no planned indicators were formulated. In method 2 the expert was measuring the design success in terms of outcome. So higher numbers were obtained for the projects A, C and D.

Combining the results of the content validity and the criterium validity it was decided to:

- Redesign the questionnaire on specific subjects. More indicators were described for the level cooperativeness of the contracting environment and the level of stability of the design environment. Some questions were reformulated to increase the comprehensibility of the questionnaire. So, a version 2 questionnaire was put together. This version 2 questionnaire was used in the survey.
- Change the way of approaching the project managers. At first, the intention was to send the questionnaire to the different project managers in the same set-up as for the criterium validity. They would have had to fill in the questionnaire and send it back by post. The weaknesses of this data gathering approach were that this left

the researcher in uncertainty as to the expected number of returned questionnaires, the returned questionnaire might not be filled in completely or might be inaccurate. The project manager monitoring the content validity research pointed out that a lot of questionnaires were sent to project managers of EDI projects. Due to time constraints most project managers would not respond. He suggested that a personal approach would be more successful. Therefore it was decided, firstly, to send a letter to the project managers, secondly, to phone to ask for their cooperation and to make an appointment, thirdly, to go to the project manager and use the questionnaire in a structured interview setting. Project managers were also more likely to cooperate if the results of the study were presented anonymously. With the project managers it was agreed that, after finishing the survey research, a report would be sent with the results presented anonymously in such a way that they could compare their own results with the other project results.

Construct Validity

An article by Bagozzi et al. (1991) deals with construct validity in organizational research. Construct validity, which is defined broadly as the extent to which an operationalization measures the concept it is supposed to measure, has been singled-out as a central issue in organizational research. Measurement error can be divided into random error and systematic error, such as method variance. Method variance refers to variance attributable to the measurement method rather than to the construct of interest; examples include archival biases, key-informant prejudices or limitation, halo effects, social desirability, and acquiescence. Random error tends to attenuate the observed relationships among variables in statistical analysis and may induce errors in inference. Method variance may also bias results by inflating the observed relationships between variables measured using a common method.

In this study the construct validity is related to the testing of the hypotheses. This means, that if a hypothesis is rejected, then the construct validity is poor or the hypothesis is really rejected. Further research needs to be done. If a hypothesis is not rejected, then the construct validity is good and the hypothesis is really not rejected. One exception to be made here is when a mistake occurs of a secondary nature, in which both are wrong in such a way that they compensate each other.

Reliability of the measuring-instrument

Three different types of reliability are distinguished: test-retest method, parallel test method and the method of internal consistency (Janssens 1983; Meerling 1984). The assumption of the test-retest method is that a repeat of a test must lead to the same results. The parallel test method assumes that two different types of measuring-instruments for one model variable must lead to the same results. The method of internal consistency assumes that a measuring-instrument is build up out of a few smaller instruments. Those instruments reflect the variables of the research model. Each variable is measured by several questions and the answers have to be related to each other to represent the variable in a reliable way. The relationship is a measure for the internal consistency.

All the different methods have their own problems. Therefore, in most of the studies, the reliability of the measuring-instrument is not defined before the survey is held. Janssens (1983) states that:

> *'In fact most of the questions are asked in the head research and afterwards the reliability is defined with help of the method of internal consistency. When the measuring-instrument is reliable, then its alright. When it's not reliable, then the researcher has to be very cautious with the conclusions of the research.'*

In this research the reliability of the measuring-instrument was also defined with the method of internal consistency by testing the data of the survey on reliability. The reliability of the responses to all instruments was assessed primarily by means of Cronbach's alpha reliability coefficient (Cronbach 1951). The reliability of several components of the model (contracting environment, contracting management, design environment and design management) are defined by Cronbach's alpha. For example, Cronbach's alpha says something about the way the questions belonging to contracting management are related to each other and in what way these questions represent the level of contracting management. For early stages of basic research, Nunnally suggests reliabilities of 0.50 suffice and that increasing reliabilities beyond 0.80 are probably wasteful (Nunnally 1978). The reliability or internal consistency of EDI system-design success is investigated by determining the correlation coefficients between the scores for the dimensions quality, costs and time, and the score for the EDI system-design success.

Internal consistency

Cronbach's alpha is calculated for the variables level of cooperativeness of the contracting environment, level of contracting management, level of stability of the design environment, and level of design management. This is shown in the following tables. It is important to remember that Cronbach's alpha, thus the internal consistency, is defined on the basis of all the cases which had answers for all the relevant questions. So, there is no disturbance if the missing values are replaced by the mean.

Table 5.2 presents Cronbach's alpha for the level of cooperativeness of the contracting environment e.g. the sector. Twenty-four respondents had answered all the questions (D1 to D5). The mean, standard deviation (Std Dev), the corrected item to total correlation, the alpha if the item is deleted and Cronbach's alpha for the five items or indicators are presented. Especially the last two columns are important in defining the internal consistency.

Table 5.2: internal consistency of level of cooperativeness of the contracting environment (N=24).

Indicator	Mean	Std Dev	Corrected item-total correlation	Alpha if item deleted
D1 Competition	3.5833	1.5299	-.2711	.0046
D2 Growth cycle	2.5833	.9286	-.0136	-.5403
D3 Product/market cycle	2.6667	1.0495	-.0486	-.5008
D4 Bargaining power	1.4167	.6539	-.3175	-.1793
D5 Branch organization	2.3750	1.3453	-.0907	-.4693
			Alpha =	-.4349

The table shows that Cronbach's alpha is almost -0.43. This is insufficient (Nunnally 1967). When we look at the table, it is obvious that all the items have very low correlation coefficients with level of cooperativeness as a whole. This is a very strong indication that probably all these items are not good as indicators for the level of cooperativeness of the contracting environment. Theoretically D5 seems to represent the level of cooperativeness most closely. Therefore D5 was chosen as the only indicator for the level of cooperativeness. Of course we have to be very cautious in interpreting the results.

In table 5.3 Cronbach's alpha for the level of contracting management is defined. In this case 34 respondents had answered all the questions (C1 to C7).

Table 5.3: internal consistency of level of contracting management (N=34).

Indicator	Mean	Std Dev	Corrected item-total correlation	Alpha if item deleted
C1 Strategic planning	2.2059	1.0084	.4609	.3779
C2 Costs/benefits	2.2353	.9865	.2943	.4556
C3 Demonstrable benefits	3.3824	1.1551	.1360	.5312
C4 Partner choice	3.3529	1.1516	.0452	.5715
C5 Human resources	3.2059	.9138	.5033	.3702
C6 Mutual trust	4.0294	.7582	-.1981	.6074
C7 Planning	2.4706	.9609	.6240	.3053
			Alpha =	.5133

The table shows that Cronbach's alpha is 0.51. This is sufficient for earlier stages of basic research (Nunnally 1978). However, some explanations have to be given. In table 5.3 'C6 Mutual trust' has a very low correlation (-0.1981) with level of contracting management as a whole. When this item is deleted, alpha rises to 0.61. The same kind of remark can be made about 'C4 Partner choice', and to a lesser extent about 'C3 Demonstrable benefits'. This indicates that these items, especially 'C6 Mutual trust' are perhaps not that good as indicators for level of contracting management. In table 5.4 Cronbach's alpha for the level of stability of the design environment is presented. Thirty-three respondents answered all the questions (I1 to I5).

Table 5.4: internal consistency of level of stability of the design environment (N=33).

Indicator	Mean	Std Dev	Corrected item-total correlation	Alpha if item deleted
I1 Automatization level	2.6364	1.4102	.3794	.4569
I2 Difference in automatiz.	2.8788	1.3638	.5352	.3590
I3 Organizational changes	3.1212	1.2185	.2855	.5135
I4 Organizational size	2.7273	1.3755	.3657	.4663
I5 Legal/fiscal aspects	3.9394	1.5194	.0700	.6446
			Alpha =	.5528

The table shows that Cronbach's alpha is 0.55. Again, this is sufficient for the earlier stages of basic research (Nunnally 1978). Only one remark has to be made about item 'I5 Legal/fiscal aspects'. This item has a low correlation (.0700) with the entire level of stability. This is an indication that this item is not good as an indicator. For this reason item I5 was deleted. This resulted in an alpha of 0.64 (N=33).

The next table 5.5 represents Cronbach's alpha for the level of design management. Twenty-four respondents answered all the questions (H1 to H25).

Table 5.5: internal consistency of level of design management (N=24)

Indicator	Mean	Std Dev	Corrected item-total correlation	Alpha if item deleted
H1 Policy	2.4167	.7755	.0110	.8328
H2 Oversight	2.4583	1.0206	.0381	.8344
H3 Resources	2.2917	1.2329	.5520	.8137
H4 Human resources	2.3333	.8681	-.1124	.8374
H5 Experience	2.7500	1.0734	.3399	.8233
H6 Representation actors	3.9167	.9743	.3556	.8227
H7 Communication	3.5417	1.1025	.4142	.8203
H8 Training	1.4583	.7211	.0133	.8323
H9 Planning	2.7083	.7506	.4702	.8201
H10 Tracking	2.5000	.9780	.1509	.8300
H11 Project control	2.2500	.6079	.2546	.8262
H12 Subcontracting	2.1667	1.0495	.3599	.8225
H13 Connection decisions	3.5833	1.0598	.4402	.8193
H14 Definition	2.4167	1.1389	.5482	.8144
H15 Execution	2.4167	1.3805	.7243	.8038
H16 Analysis	2.0000	.7802	.3975	.8220
H17 Control	2.4583	.5882	.5504	.8199
H18 Technology insertion	1.6667	.9631	.2999	.8247
H19 Technology environment	2.2500	1.4521	.4613	.8180
H20 Technical architecture	3.8333	1.1672	.6287	.8106
H21 Datamodelling design	4.2500	.7372	.4154	.8217
H22 Message standardization	3.6667	1.6330	.4424	.8197
H23 Standard EDI software	3.2083	1.7440	.4599	.8192
H24 User involvement	3.7500	1.1132	.2243	.8280
H25 Organizational design	3.2917	1.1971	.5958	.8119
			Alpha =	.8282

The table shows that Cronbach's alpha is 0.83. This is more than sufficient for the earlier stages of basic research (Nunnally 1978). Just a few items H1, H2, H4 and H8 do have a relatively low correlation with level of design management as a whole. When these items are deleted, alpha rises a little. This is a slight indication that perhaps these questions are not that good as indicators for level of design management.

EDI system-design success

As mentioned before, the internal consistency of the EDI system-design success is investigated by determining the correlation coefficients between the scores for the dimensions quality, costs and time, and the score for the EDI system-design success. Table 5.6 gives an overview of the correlation coefficients with 2-tailed significance (N=28). For a 2-tailed significance $p < 0.10$ is appropriate.

Table 5.6: correlation of the three dimensions with EDI system-design success (N= 28).

Dimension	(Q_{ds})	(C_{ds})	(T_{ds})	(EDS)
Quality (Q_{ds})	1.000	.107 ***	-.362 **	.493 *
Costs (C_{ds})	.107 ***	1.000	.354 **	.830 *
Time (T_{ds})	-.362 **	.354 **	1.000	.452 **
EDI system-design success (EDS)	.493 *	.830 *	.452 **	1.000

* = p < 0.01, ** = p < 0.10, *** = p > 0.10.

The table makes clear that:

- There is a significant positive correlation (.493) between the Quality dimension and the overall EDI system-design success;
- There is a significant positive correlation (.830) between the Costs dimension and the overall EDI system-design success;
- There is a significant positive correlation (.452) between the Time dimension and the overall EDI system-design success;
- There is no significant correlation between the Quality dimension and the Costs dimension. This can be interpreted as coming closer to the realized quality of the EDI system but does not imply that realized costs come closer to planned costs or realized costs are exceeding planned costs.
- There is a negative significant correlation (-.362) between the Quality dimension and the Time dimension. This can be interpreted as: if the realized quality of the EDI system is closer to the planned quality then the realized delivery time is later then the planned delivery time (date due);

- There is a positive significant correlation (.354) between the Costs dimension and the Time dimension. This can be interpreted as: if the realized costs of the EDI system are closer to the planned costs then the realized delivery time is closer to the planned delivery time;
- Overall, all three dimensions correlated well with EDI system-design success. The results can be used for further analysis.

5.5 Data analysis methods

This section describes and discusses the methods used to analyze the data of the survey. In general these methods are called multi-variate analysis methods. In this study, methods like single and multiple regression analysis, path analysis and factor analysis were used. These methods are described in general. For a detailed description see, for example, Churchill (1987) and Nooij (1990). The survey data were analyzed with the help of SPSS (Huizingh 1990; Nie et al. 1975). The results of the data analysis are presented in chapter 6.

Single Regression Analysis

Single regression analysis refers to the technique used to derive an equation that relates the dependent variable to one dependent (predictor) variable. This study investigates the relationship between one dependent variable (Y_i) and one independent variable (X_i). In single regression, the method of least squares is used to search for the line of 'best fit' for the statistical model, $Y_i = a_1 + b_1 * X_{1i} + e_i$. Here a_1 is called the intercept, b_1 the slope or regression coefficient, e_i is called the error or disturbance which is the difference between the observed value of Y_i and the subpopulation mean at the point X_i. The e_i are assumed to be normally distributed, independent, random variables with a mean of 0 and a constant variance.

The beta-coefficient or standardized regression coefficient is the regression coefficient multiplied by the ratio of the standard deviation of the independent variable to the standard deviation of the dependent variable. An important part of any statistical procedure that builds models from data is establishing how well the model actually fits. A commonly used measure of the goodness of fit of a linear model is R Square or the coefficient of determination (R^2). For example if $R^2 = 0.77$, this means that 77 percent of the variation in the dependent variable can be explained by the variation in the independent variable.

Single regression defines the percentage of variation of the dependent variable explained by the independent variable. This is called the percentage of variation explained by the linear model. A frequently tested hypothesis is that there is no linear relationship between X and Y, that the slope of the population regression line is 0. It is called the null-hypothesis (H_0). This leads to a judgement like 'the null-hypothesis will be rejected with an unreliability coefficient of 1,2345 %'. Usually a judgement like this will be significant if the unreliability is less then 10 %.

The use of single regression analysis is allowed if the variables are being measured at (quasi) interval scale (Segers and Hagenaars 1980).

Multiple Regression Analysis

Multiple regression analysis differs from single regression analysis in that it investigates the relationships between one dependent variable and several independent variables. Multiple regression searches for the best suitable formula of the model, $Y_i = a_i + b_1 * X_{1i} + b_2 * X_{2i} + b_3 * X_{3i} + \ldots\ldots + e_i$. Again, Y_i is called the dependent variable, X_i the independent variable, a the intercept, b the regression coefficient and e_i the error, see figure 5.1.

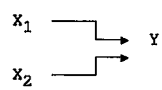


Figure 5.1:model of multiple regression analysis.

Multiple regression also defines the percentage of variation of the dependent variable explained by the independent variables. This is called the percentage of variation explained by the model. Two types of significance of the model will be defined. First, the significance of the model will be judged by defining the unreliability coefficient of rejecting the 0-hypotheses that there is no relationship between the dependent variable Y and the independent variables X. Second, what is the significance of each independent variable. This is done by defining the unreliability coefficient of rejecting the hypotheses that there is no relationship between the dependent variable Y and the independent variable X, in which the influence of the other independent variables are eliminated. Besides the assumptions of single regression analysis, an additional assumption is that there can be no interaction effects which are not included in the multiple regression model. Interaction occurs when the direction and/or strength of the relationship between two variables is different within the categories of a third variable (Segers and Hagenaars 1980:51). The following assumptions are important in testing the null hypothesis that b=0:

- The regression line is linear;
- There is no autocorrelation;
- There is no heteroskedasticy;
- The residue scores are normally distributed.

Autocorrelation was not expected because no time series were involved. The assumption with regard to linearity, heteroskedasticy and normality can be investigated by making a scatter diagram and a partial diagram related to the residue scores. In this study both diagrams were calculated for the variables of the research model. For these variables it was concluded that the assumptions were applicable to the survey data.

Path Analysis

Path analysis is a multiple regression technique particularly suited to the investigation of sequential models such as that proposed in this study, see, for example, Tait and Vessey (1988). Path analysis was used to estimate the relations between contracting management, contracting success, design management and EDI system-design success. One of the major strengths of path analysis is its ability to distinguish between the different effects of one variable on another, see figure 5.2. The effects of variables on other variables can be denoted by their standardized regression (beta) coefficients or path coefficients. Path analysis permits the researcher to decompose the correlation between an exogenous and an endogenous variable, or between two endogenous variables, into the following components (Steenkamp 1989:145):

- Direct effects of one variable via mediating variables;
- Indirect effects via mediating variables;
- Unanalyzed effects due to correlated causes;
- Spurious effects due to common causes.

The sum of the direct effect and the indirect effect is called the total effect of one variable on another. In path analysis attention is mainly devoted to decomposition of the total effect or causal part of the correlation coefficient into direct and indirect effects (Steenkamp 1989). Path analysis assumes that the relationships between the variables in the model are linear additive. This implies that the marginal effect of variable A on variable B is independent of the value of A. Further the effect of A on B does not depend upon the value of other predictor variables. Most studies using path analysis consider only the main effects of variables because this allows unambiguous decomposition of the total effects of the variable into its direct and indirect effects. Such procedure is only justified if the nonlinear effects explain little of the total variance explained in the dependent variable (Steenkamp 1989:146).

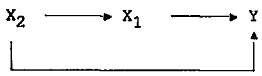


Figure 5.2:model of path analysis.

Factor analysis

Factor analysis shares some similarities and shows some differences from regression analysis. Both analysis methods use variables measured on an interval level. In both situations regression coefficients play an important role. The difference is that in factor analysis no distinction is made between independent and dependent variables. In factor analysis one searches for new variables - not observed but constructed - which reflect the observed variables as well as possible (Nooij 1990:128). The purpose of factor analysis is data reduction and substantive interpretation (Churchill 1987). The originally observed variables are reduced to a smaller number of constructed variables which are then interpreted. The new constructed variables are called 'factors', see figure 5.3. In this figure F_1 and F_2 are the constructed factors and X_1, X_2, X_3, X_4 are the observed variables.

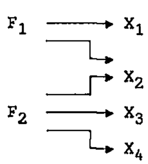


Figure 5.3:model of factor analysis.

Within factor analysis different types occur: principal component analysis, principal axis factoring, unweighed least squares factor analysis, and generalized least squares factor analysis. This study opted for the, much used, principal component analysis. In principal component analysis every component is a linear combination of the original variables. Component analysis tries to reproduce the total variance of the variables by minimalizing the rectangular distance of one datapoint to an axis (component). The first component is defined by the way it contains most of the information and explains most of the variance in the data. The second component is defined in the same way, under the assumption that it is vertical to the first component. In this way, as many components as variables can be extracted. There are a few criteria which define the number of components to be extracted. It is best to use all the criteria together. The criteria are:

. Determine the suitability of the data. To determine the suitability of the data of the variables, the Bartlett Test of Sphericity, the Significance Level and the Kaiser-Meyer-Olkin Measure of Sampling Adequacy are all calculated;
. Order the factors in terms of size and add factors, until the last factor has an eigen value of 1. Factors with an eigen value smaller then 1 explain less of the variance;
. Make a scree-plot (Cattel 1966) with the eigen values on the vertical axis in decreasing order, and on the horizontal axis the number of the corresponding factors. There is a drop to be seen, where the eigen values of the factors suddenly drop.
. Order the factors in terms of size and take the factors which explain at least 5% of the variance.

The basis for component analysis is a correlation matrix of all variables. Sometimes not all variables could be measured for the population. These are the missing values. There are three ways to deal with missing values: listwise deletion, pairwise deletion, and mean substitution. This study used mean substitution. To come to a better interpretation, the factors are rotated. There are several standard procedures for rotating: quartimax, varimax, direct oblimin. This study used varimax because in this procedure the factors are rotated in such a way that within each factor a maximum spread of loadings exists. Factor loadings show the correlation between the variable and the factor. Some variables load very high, others low. The solution is still orthogonal. In this study factor analysis was executed on the items of contracting management and design management. The results are presented in chapter 6.

Lisrel

The computer program LISREL (Linear Structural RELationships) (Jöreskog and Sörbom 1984) combines the possibilities of regression analysis, path analysis and factor analysis. The program has the scope to execute a path analysis on variables constructed with a factor analysis. A requirement of LISREL is that the multi-item content of variables and the relationships between the variables are specified a priori. For this study LISREL was not appropriate for two reasons (see Holbrook 1981). First, the literature provides little guidance with respect to the nature and occurrence of interaction effects and to the effect of, for example, indicators of level of design management on EDI system-design success. In these circumstances path analysis is a more appropriate analytical technique than LISREL (Holbrook 1981; Pedhazur 1982). Second, the number of observations was insufficient for this approach. Boomsma (1982) has found that the robustness of LISREL for small sample sizes is limited. He concluded that it is dangerous to use sample sizes smaller than 100 because the researcher runs severe risks, such as the likelihood of non-convergence.

5.6 Summary

The following questions were answered in this chapter:

. How can the research model be measured in a quantitative way?

- In this chapter the survey research method as research approach and EDI projects as research material was chosen. A questionnaire was developed as a measuring-instrument. The questionnaire was used in a structured interview setting with EDI project managers.

. What is the quality of the measuring-instrument?

- The quality of the measuring-instrument (questionnaire) was investigated in terms of validity and reliability. The validity has been determined by defining the content-criterium- and construct validity. The reliability of the measuring-instrument was investigated using the method of internal consistency and by determining the correlation coefficients of the survey data.

As a result of defining the content validity, the questionnaire had to be changed in terms of clarity and comprehensibility. As a result of defining the criterium validity, the questionnaire was redesigned on specific subjects. More indicators were described for level of cooperativeness of the contracting environment and the level of stability of the design environment and some questions were reformulated to increase the comprehensibility of the questionnaire. In view of the content validity and the criterium validity, it was decided to approach the project managers in a different way from that initially proposed. Instead of sending the questionnaire by post, it was decided that the project managers should be visited and the questionnaire used in a structured interview setting.

The reliability of the instruments with regard to level of cooperativeness of the contracting environment, level of contracting management, level of stability of the design environment and level of design management were assessed primarily by means of Cronbach's alpha reliability coefficient (Cronbach 1951). Cronbach's alpha is insufficient for the level of cooperativeness of the contracting environment. Therefore further research is recommended to improve indicators for this instrument. One has to be very cautious when using the results of this instrument in further analysis. Cronbach's alpha for the other three instruments are sufficient. So the results of these instruments can be used in further analysis. However, there are still some indicators belonging to each instrument which might not be such good indicators. These indicators have to be investigated in more detail.

The internal consistency of EDI system-design success is investigated by determining the correlation coefficients between the scores for the dimensions quality, costs and delivery time, and the score for EDI system-design success. There is a high correlation of the three dimensions with the score for EDI system-design success. Also, the direction of the regression coefficients are all positive. Based on these results it can be concluded that the internal consistency of the instrument of EDI system-design success is satisfactory.

. How can the data be analyzed with the help of which data analysis method?

- The data could be analyzed by using multi-variate analysis methods. In this study we are interested in the relationship between the variables of the research model and the variation of the dependent variable explained by the independent variable(s). Single regression, multiple regression and path analysis are useful in serving those interests. Factors concerning contracting management and design management will be distinguished by using factor analysis.

- Are the data suitable for those data analysis methods?

- Assumptions arrived at due to these analysis methods being used on the data were investigated. It was appropriate to analyze the data using these methods.

6 ANALYSIS OF THE SURVEY DATA

6.1. Introduction

With the help of the measuring-instrument, discussed in chapter 5, survey data were gathered related to the Design Management Theory. Preliminary results were reported in Bozon and Van Heck (1992); and Van Heck et al. (1992a and 1992b). In this chapter the survey data will be analyzed. Two central questions run through it like a continuous thread. Those questions were:

- What factors are responsible for the success or failure of the design of an EDI system?
- How are these factors related to the success or failure of the design of an EDI system?

In section 6.2 an analysis will be made of the response to the survey and general EDI project variables will be analyzed. In section 6.3 the general results with regard to the variables will be analyzed. In section 6.4 the hypotheses will be tested. In section 6.5 the variables 'level of contracting management' and 'level of design management' will be analyzed using factor analysis. In section 6.6 additional analysis will take place with regard to the subjective measurement of contracting success and EDI system-design success and with regard to EDI system-implementation success.

6.2. Analysis of response and EDI projects' characteristics

Response and non-response

First the analysis of the response and non-response to the survey will be given. Out of the 91 EDI projects described in Ediforum (1991) 50 projects were chosen, because the design process of these projects had just been completed. The project managers of these 50 EDI projects were sent a letter about the research. Ultimately 36 appointments for interviews were made, 35 of the 36 interviews were appropriate. The useful response was 70%. This is shown in the left circle in figure 6.1. The left figure also makes it clear that the non-response applies to 15 EDI projects. The right circle in figure 6.1 shows the analysis of the non-response. From these 15 EDI projects, there were 5 EDI project contact persons who could not be reached and 4 contact persons did not want to collaborate because they did not have the time. A further 3 contact persons were willing to cooperate but were convinced that their projects were not suitable, because there was no project organization, no project manager or the project was only technical. There were 2 contact persons who recieved two letters about two different EDI projects. Together with the interviewer, the contact person chose one EDI project. Finally, 1 interview held involved the design of a global technical network therefore this interview was not taken into the analysis.

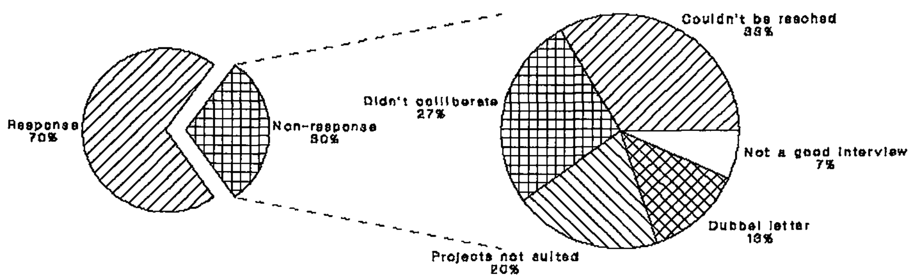


Figure 6.1 : analysis of the response and non-response of the survey.

In the questionnaire accompanying the survey, the first ten questions were about the background of the EDI project. Each of these questions will be analyzed in the next figures by using pie-charts.

Related sector

The first question was about the sector the EDI project was related to. There were nine categories, derived from Ediforum (1991). These categories were; agriculture, industry, construction, trade, transport/storage, banking/insurance, healthcare, and government. The results are presented in figure 6.2.

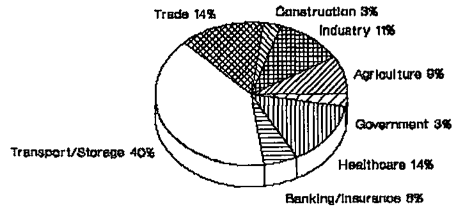


Figure 6.2 : related sector of the EDI project.

A majority of the projects (40%) are related to the transport and storage sector. There was one project related to the construction sector and one project related to government. A further analysis was carried out on how the research population represented the population of EDI projects in 1991 in the Netherlands as described by Ediforum. Ediforum is the National Dutch EDI organization. In 1991 the Ediforum population amounted to 91 EDI projects (Ediforum 1991). The Ediforum result is the most accurate result available. The total population of EDI projects in the Netherlands will probably be higher, because some projects did not make themselves known to Ediforum. The results are presented in table 6.1.

Table 6.1: comparison of survey projects and Ediforum projects.

Sector	Response	Ediforum
Agriculture	3 (9%)	7 (8%)
Industry	4 (11%)	9 (10%)
Construction	1 (3%)	1 (1%)
Trade	5 (14%)	20 (22%)
Transport/Storage	14 (40%)	22 (24%)
Banking/Insurance	2 (6%)	2 (2%)
Healthcare	5 (14%)	7 (8%)
Government	1 (3%)	16 (18%)
Other	0 (0%)	7 (8%)
Total	35 EDI projects	91 EDI projects

As one can see, the distribution of the survey is quite comparable with the distribution of the EDI projects in Ediforum. If the survey population is compared to the Ediforum population there are relatively more transport and health care projects and fewer trade and government projects. The response population is not a sample taken at random from the Ediforum population or the total population.

Size of the EDI project

Figure 6.3 shows the size of the EDI project in terms of months of labour. There were four answering categories; less then 12 months, 12 to 48 months, 49 to 200 months and more then 200 months.

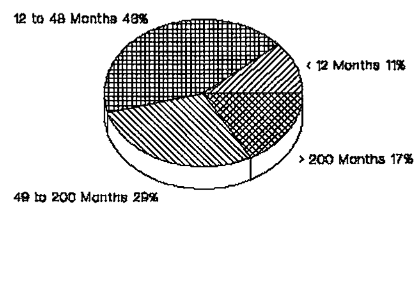


Figure 6.3 : size of the EDI project.

Most of the EDI projects (43%) are relatively small (12 to 48 months). But some projects (17%) were big in terms of months of labour.

Number of organizations

Figure 6.4 shows the number of organizations involved in the EDI project. There were eight answering categories: 2 organizations, 3 - 10, 11 - 25, 26 - 50, 51 - 100, 101 - 250, 251 - 1000 organizations and more then 1000 organizations.

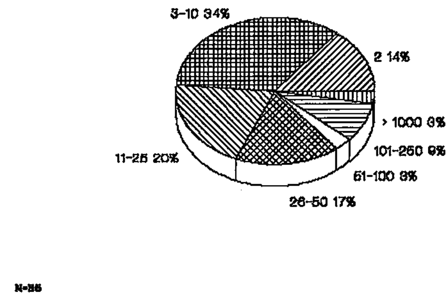


Figure 6.4 : number of organizations involved in the EDI project.

Most of the EDI projects (34%) are in the category of 3 - 10 organizations. There were no EDI projects where the number of organizations involved was between 250 - 1000 organizations and there was one EDI project with more than 1000 organizations.

Number of messages

Figure 6.5 shows the number of messages designed in the EDI project. There were five answering categories: 1 message, 2 - 4, 5 - 10, 11 - 20 and more then 21 messages.

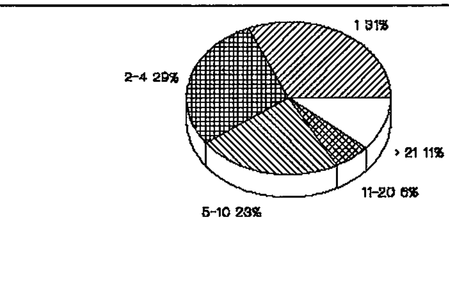


Figure 6.5 : number of messages designed in the EDI project.

Most of the EDI projects (31%) develop just one message. Although 11% of the projects are develop a range of messages (categorie > 21).

Form of communication

Figure 6.6 represents the form of communication of EDI messages to be designed in the EDI project. There were six answering categories; direct communication, videotex, electronic mailbox, paper, floppy or a category called other.

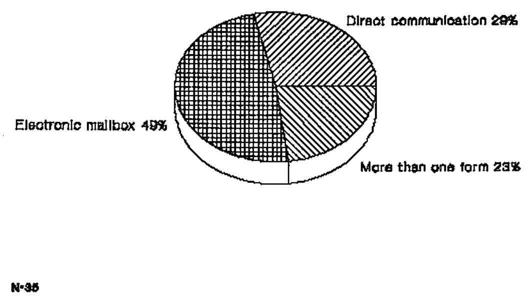


Figure 6.6 :form of communication for the design of EDI messages.

Most of the EDI projects (49%) used electronic mailbox. A further 29% used direct communication and 23% used more then one form (mostly electronic mailbox in combination with direct communication or videotex). It can be concluded that most EDI projects were indeed developing EDI, although a small number (29%) are developing a really integrative EDI system.

Strategic purpose

Figure 6.7 is about the strategic purpose that was the determining factor in initiating the EDI project. There are nine answering categories: identifing and making accessible technologies and markets (category 0), gaining knowledge and facilities on existing technologies (category 1), allowing fast and effective preparation for new openings in the market (category 2), fast building-up of a market position (category 3), building-up continuity by means of specialization (category 4), pursuit of critical scale size (category 5), pursuit of cost price leadership (category 6), retreat from a certain market (category 7) and no specific strategic objective (category 8). From the 35 EDI projects, four answers were not used because they gave two or more strategic purposes or because they gave a non-categorized strategic purpose.

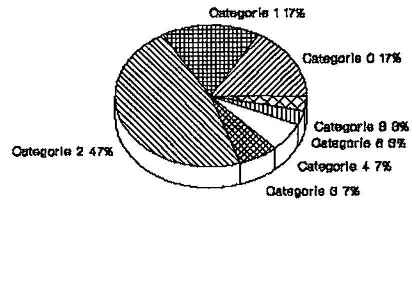


Figure 6.7 : strategic purpose of the EDI project.

It is obvious that fast and effective preparation for new openings in the market (category 2) has the most important role to play in the EDI projects (47%). To identify and make accessible new technologies and markets (category 0) and gaining knowledge and facilities of existing technologies (category 1) play an important role too (17% each). Building up continuity (category 5) and retreat from a certain market (category 7) are not strategic purposes for the initiation of an EDI project.

Type of EDI project

One question was about the type of EDI project: an experimental pilot project or a continuation project. There are almost as many continuation projects (44%) as there are experimental projects (56%). It can be concluded that for many organizations this project is their first experience of EDI. One case is missing because the respondent did not know the answer.

Current process

Figure 6.8 shows the process the EDI project was in at the moment the respondent was interviewed. Six answer categories were possible: contracting process, design process, building process, implementation process, usage process and a category called other.

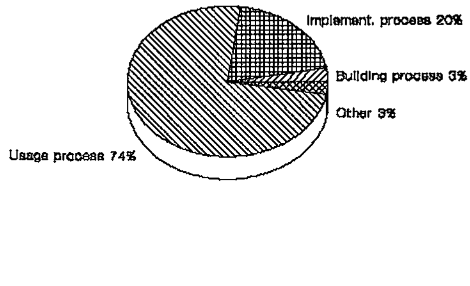


Figure 6.8 : current process of the EDI project.

Figure 6.8 shows that almost all of the EDI projects are in the usage process (74%) or in the implementation process (20%). One EDI project (3%) was still in the building process and one EDI project (3%) was in the category 'other' because it had been wound up. It can be concluded that all the investigated EDI projects finished the design process. It was possible to investigate the EDI system-design success.

Position of the respondent

The last question in this section dealt with the position of the respondent in the EDI project. In total there were 14 categories the respondent could choose from. Figure 6.9 represents their positions.

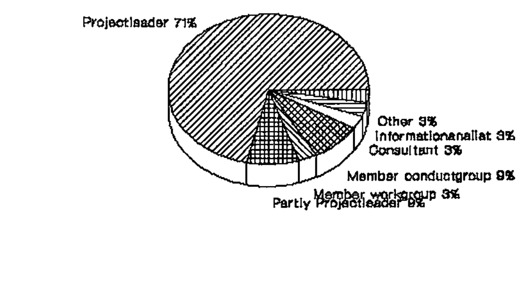


Figure 6.9: position of the respondent within the EDI project.

Most of the respondents (71%) had a position as project leader or project manager within the EDI project. Some of them (9%) were partly project manager or member of the conduct group (9%). The respondents were also asked to state which activities they performed in the EDI project. Those activities were typically project manager activities like specifying the cooperation contract, developing the project organization, planning the project, budget control of the project, quality control of the project, attracting project members, approving project products. All respondents performed most of these activities in their project. The conclusion is that the respondents could be viewed as project managers of the EDI projects and the answers given by different respondents could, in this sense, be compared with each other.

6.3 Results with regard to model variables

The analysis and presentation of the general results follows the life cycle of the EDI system design, as represented in the research model. Firstly, the results of the contracting environment will be presented and afterwards contracting management, contracting success, design environment, design management and EDI system design success. For each variable some general statistics will be presented. These general statistics involves the mean, standard deviation, minimum and maximum value, and the number of cases which could respond to this indicator.

Contracting Environment

Five indicators were defined related to the level of cooperativeness of the contracting environment. Five questions were implemented in the questionnaire (see appendix 1, section D). In table 6.2 the mean, the standard deviation, the minimum and maximum, and the number of cases for each question over all the answers are given.

Table 6.2: general results level of cooperativeness of contracting environment.

Question	Mean	Std Dev	Minimum	Maximum	Number of cases
D1 Competition	3.32	0.76	1	5	34
D2 Growth cycle	2.58	0.95	1	4	31
D3 Product/market cycle	2.70	1.65	1	5	27
D4 Bargaining power	1.55	0.85	1	3	33
D5 Branch organization	2.26	1.14	1	5	35

More than one respondent was not able to answer all the questions on the contracting environment. For the questions D1 to D4, there are one or more missing values. This is a signal that these questions might not be very good indicators. As described in section 5.4, D5 was chosen as the indicator based on its reliability and on theoretical grounds. The value of this question represents the level of cooperativeness of the contracting environment which is shown for each project in figure 6.10.

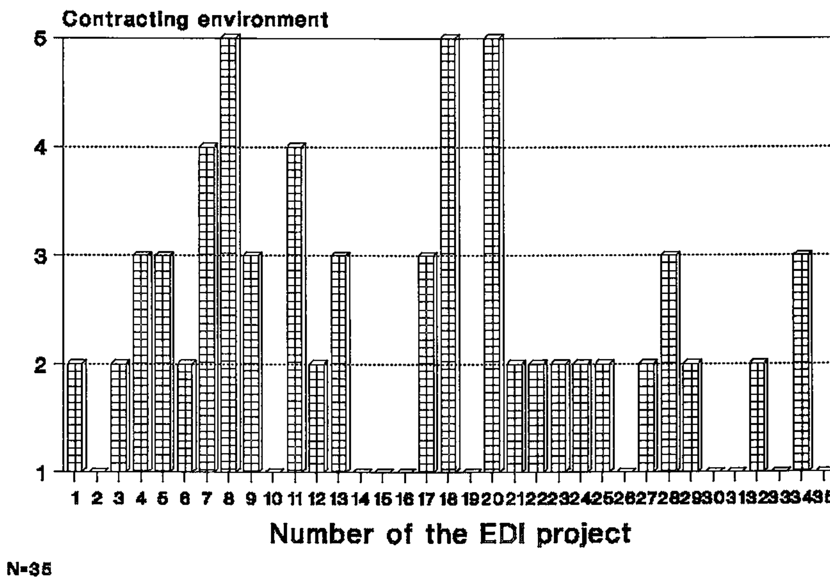


Figure 6.10: *level of cooperativeness of contracting environment (1 is low level; 5 is high level).*

A higher score on level of cooperativeness of the contracting environment indicates that the sector related to the EDI project is working together more closely or, more specifically, in that sector, EDI or branch organizations are more organized and involved. The average level of contracting environment was 2.26 on a scale of 1 to 5. The level of contracting environment differentiated between 1.00 and 5.00 with a standard deviation of 1.14.

Contracting Management

There were seven questions defined in the questionnaire which were related to the level of contracting management (see appendix 1, section C). In table 6.3 the results are given.

Table 6.3: general results level of contracting management.

Question	Mean	Std Dev	Minimum	Maximum	Number of cases
C1 Strategic planning	2.20	0.99	1	5	35
C2 Costs/benefits	2.29	1.02	1	5	35
C3 Demonstrable benefits	3.34	1.16	1	5	35
C4 Partner choice	3.23	1.14	1	5	35
C5 Human resources	4.03	0.91	2	5	35
C6 Mutual trust	2.49	0.76	2	5	34
C7 Planning	3.32	0.95	1	5	35

As one can see, almost all the respondents could fill in the questions. Only one question (C6) could not be filled in by one respondent. In this case the missing value was replaced by the mean (2.49). The mean value of these seven questions represents the level of contracting management which is shown for each project in figure 6.11.

Figure 6.11 represents the level of contracting management for all the 35 EDI projects. A higher score on contracting management means a higher level of contracting management. The average level of contracting management was 2.99 on a scale of 1 to 5. The level of contracting management differentiated between 2.14 and 4.29 with a standard deviation of 0.50.

Also questions were asked about the first contact between the partners and the time the cooperation contract was signed. The results are presented in appendix 2. Surprisingly, in 25 cases, project managers could not give accurate information about the starting and finishing dates of the contracting process. This was due to the fact that in some cases the first contact was in the seventies and early eighties. In one case (project 30) the end date of the contracting process was after the end date of the design process. This case was not taken into account by calculating the average duration of the contracting process. The average contracting process took 7.6 months (N=10).

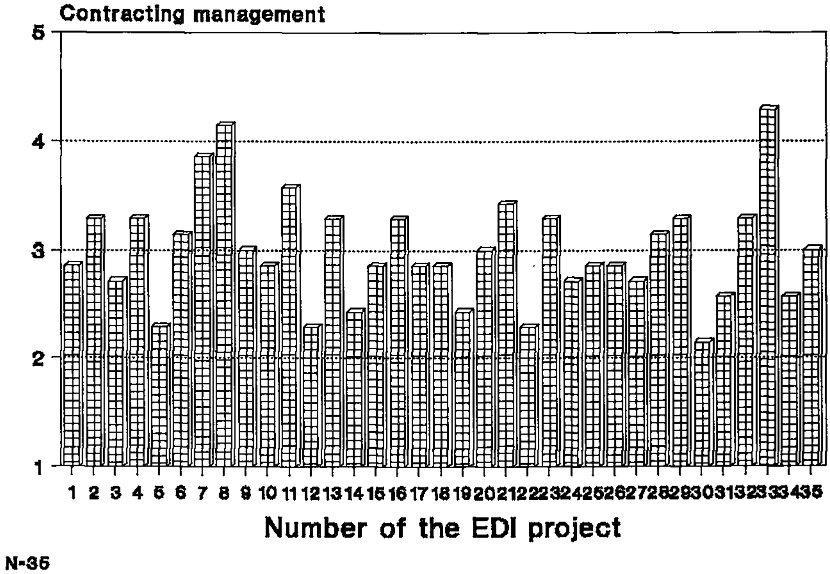


Figure 6.11: level of contracting management (1 is low level; 5 is high level).

Contracting Success

As indicated in the research model the result of the contracting process is the cooperation contract (see appendix 1, Question E4). The respondents were asked if a cooperation contract between the organizations had been specified. The results are shown in figure 6.12.

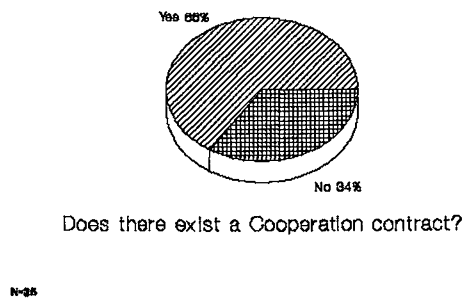
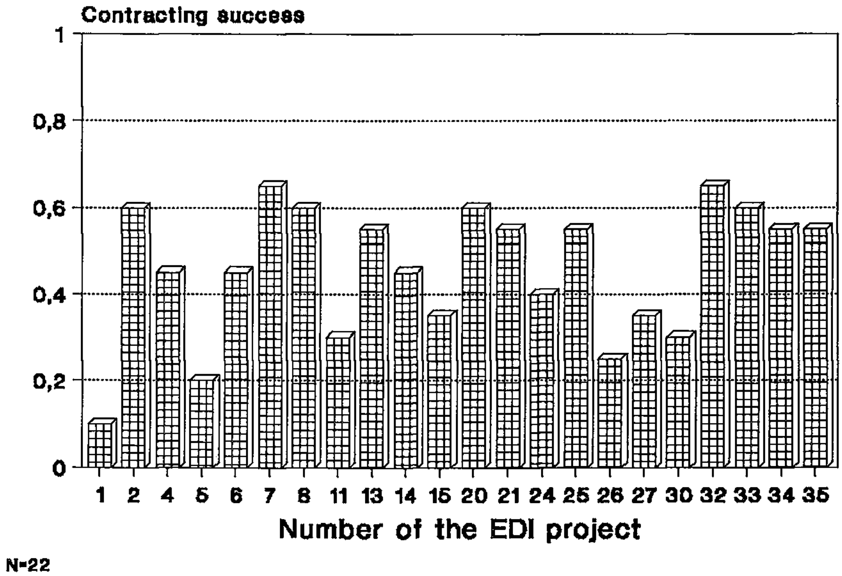


Figure 6.12 : existence of a cooperation contract.

Surprisingly, in 34% of the cases no cooperation contract existed before the design process was started. In 66% of the cases a cooperation contract existed but in one case no specification of that contract could be given. So in 22 cases the contracting success could be measured in terms of the level of specification of the cooperation contract. For each of the projects the level of contracting success is presented in figure 6.13.



Figuur 6.13: *level of contracting success (0 is not successful; 1 is successful).*

A higher score on contracting success means a more specified cooperation contract. The average level of contracting success was 0.46 on a scale of 0 to 1. The level of contracting success differentiated between 0.10 and 0.65 with a standard deviation of 0.16.

As indicators for the level of specificaton of the cooperation contract, 20 aspects of the contract were used. For each aspect the project manager was asked to indicate if the aspect was specified in the cooperation contract. For 22 cases a cooperation contract was specified. In one case it was not clear for a certain contract aspect if it was specified or not. Therefore N is sometimes 21. These results are presented in table 6.4. One can conclude that aspects related to responsibilites of the contractor and customer, costs of the EDI system design and the implemented EDI system and liability of the contractor are in the top five of specified aspects. In the bottom five one can find aspects like fines related to costs, destination of margins, tax of margins, fines related to planning and fines related to product quality.

Table 6.4: the way cooperation contracts are specified.

Aspect of cooperation contract	Specified	Not specified	N
. responsibilities of the contractor	17	4	21
. responsibilities of the customer	17	4	21
. costs of EDI system design	16	6	22
. costs of implemented EDI system	15	7	22
. liability of the contractor	14	7	21
. quality of EDI system design	14	8	22
. delivery time of EDI system design	14	8	22
. procedure of decision making	13	9	22
. deliverable reports, specifications, documents	13	9	22
. acceptance criteria	12	10	22
. delivery time of implemented EDI system	12	10	22
. internal settling of prices	11	11	22
. rules of competition	10	12	22
. acceptance procedures	10	12	22
. rights of industrial property	7	14	21
. fines related to product quality	2	19	21
. fines related to planning	2	19	21
. tax of margins	1	21	22
. destination of margins	1	21	22
. fines related to costs	0	21	21

Design Environment

Five questions were defined in the questionnaire that were related to the level of stability of the design environment e.g. how stable the organizations in the EDI projects are (see appendix 1, section I). Table 6.5 presents the results.

Table 6.5: general results level of stability of design environment.

Question	Mean	Std Dev	Minimum	Maximum	Number of cases
I1 Automatization level	2.74	1.44	1	5	35
I2 Difference in automatization	2.88	1.34	1	5	34
I3 Organizational changes	3.09	1.20	1	5	35
I4 Organizational size	2.79	1.41	1	5	34
I5 Legal/fiscal aspects	3.88	1.53	1	5	34

There were only a few respondents who could not fill in all the questions. For the questions I2, I4 and I5, there was one missing value. Therefore the missing value was replaced by their mean. As described in section 5.4, I5 was deleted on theoretical grounds. Therefore the mean value of the four remaining questions represents the level of stability of the design environment which is shown for each project in figure 6.14.

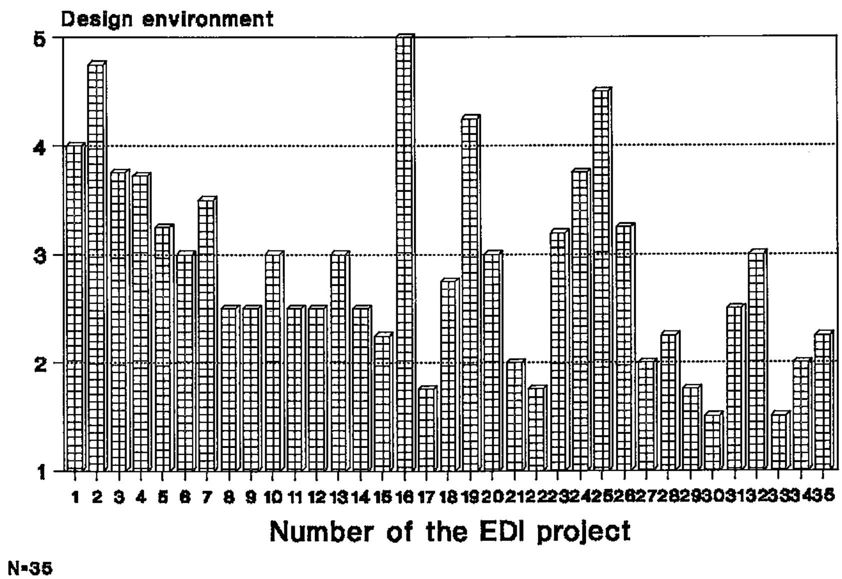


Figure 6.14: level of stability of design environment (1 is low level; 5 is high level).

A higher score on design environment means a more stable design environment e.g. more stable organizations related to the EDI project. The average level of stability of design environment was 2.88 on a scale of 1 to 5. The level of stability of design environment differentiated between 1.50 and 5.00 with a standard deviation of 0.92.

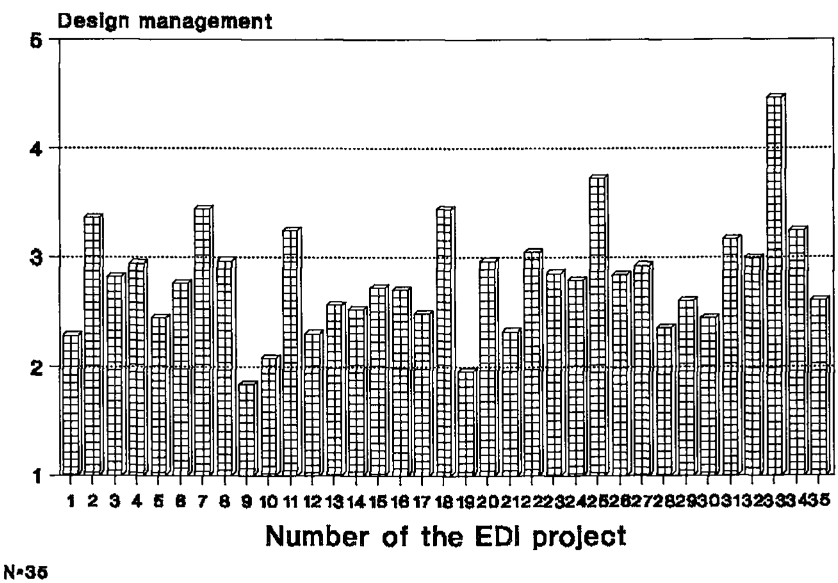
Design Management

There were twenty-five questions defined in the questionnaire which were related to the level of design management (see appendix 1, section H). In tabel 6.6 the mean, the standard deviation, the minimum and maximum and the number of cases are specified for those indicators which have some missing values.

Table 6.6 : general results of some indicators of the level of design management.

Question	Mean	Std Dev	Minimum	Maximum	Number of cases
H1 Policy	2.41	0.86	1	5	34
H4 Human resource constraints	2.47	1.01	1	5	30
H6 Representation of actors	3.94	0.90	2	5	33
H12 Subcontracting	2.03	0.97	1	5	32
H13 Connection on dec. making	3.62	1.04	2	5	34
H19 Technology environment	2.19	1.45	2	5	31
H20 Technical architecture	3.85	1.02	1	5	34
H23 Standard EDI software	3.26	1.64	1	5	34

The table shows that more than one respondent could not fill in all the questions. For the questions above, there are one or more missing values. Especially the questions concerning 'H4 Human resource constraints', 'H12 Subcontracting' and to a lesser extent 'H6 Representation of actors', have not been filled in a couple of times. Again, this is a signal that these questions are not such good indicators. Here too, the missing values have been replaced by the mean. The mean value of these twenty-five questions represents the level of design management which is shown in figure 6.15.



Figuur 6.15: *level of design management (1 is low level; 5 is high level).*

This figure represents the level of design management for all the 35 EDI projects. A higher score for design management means a higher level of design management. The average level of design management was 2.80 on a scale of 1 to 5. The level of design management differentiated between 1.84 and 4.47 with a standard deviation of 0.52.

EDI System Design

The research model shows that the result of the design process is the EDI system design. Respondents were asked if the design process resulted in an EDI system design. In 32 EDI projects the design process resulted in an EDI system design. In the other cases no EDI system design was specified. This is represented in figure 6.16.

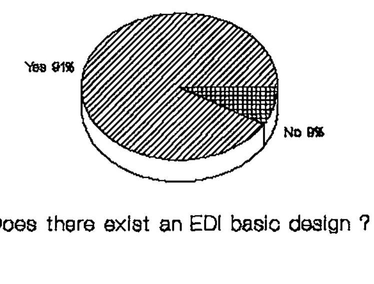


Figure 6.16: existence of an EDI system design.

As argued before, three dimensions of EDI system-design success were distinquished: planned versus realized quality, costs and delivery time of the EDI system design. The respondents were asked to specify those dimensions. In 4 cases one of the dimensions could not be specified. Therefore in 28 cases it was possible to measure these dimensions and in so doing measure EDI system-design success . First the results of the three dimensions will be discussed.

Quality dimension

A higher score on the quality dimension means that the realized quality of the EDI system design became closer to the planned quality of the EDI system design. The average quality dimension of EDI system design is 0.74 on a scale of 0 to 1. The quality dimension of the EDI system design differentiated between 0.41 and 1.00 with a standard deviation of 0.18. To compare the quality dimension results (measured at an absolute level) with the costs and time dimension results (measured on an ordinal scale) the quality dimension scores have been transformed into ordinal scores. There were four ordinal scores: 0% (realized quality is equal to planned quality), < 10% (less then 10% of the planned quality attributes were not realized), 10 to 50% (between 10 and 50% of the planned quality attributes were not realized), 50 to 100% (between 50 and 100% of the planned quality attributes were not realized). The results are shown in figure 6.17.

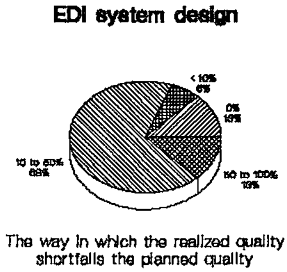


Figure 6.17: level of the quality dimension of EDI system design.

A higher percentage score on the quality dimension means that there are a greater number of quality attributes not realized. Four projects realized all planned quality attributes (category 0%), 2 projects realized their planned quality attributes for 90% (category < 10%), 21 projects realized between 50% and 90% of their planned quality attributes (category 10 - 50%), while 4 projects realized less then 50% of their planned quality attributes (category 50 - 100%). There were 19 dynamic quality attributes and 8 static quality attributes distinguished. Respondents were asked to specify if the quality attributes were completely realized in the EDI system design. The results are presented in table 6.7 for dynamic quality attributes and table 6.8 for static quality attributes.

In the top five of completely realized quality attributes are organizational certainty of the EDI system, correctness of message working up, repairableness of EDI system, availabiliy of EDI system and user-friendliness of EDI system. In the bottom five the dynamic quality attributes workability manual procedures, support decision-making, permissibility of message working up, degradation possibilities of EDI system and elasticity of EDI system are difficult to realize in the EDI system design. Degradation possibilities deal with the way the heart of the EDI system still functions if parts of the EDI system fall out. Elasticity deals with the way the EDI system continues after a disruption. The results indicate that those quality attributes contri-bute to a lower quality dimension.

Table 6.7 : realized and not realized dynamic quality attributes in the EDI system design

Static quality attributes	Completely realized in EDI system design	Not Completely realized in EDI system design	N
. organizational certainty of EDI system	27	3	30
. correctness of message working up	27	4	31
. repairableness of EDI system	27	4	31
. availability of EDI system	27	4	31
. user-friendliness of EDI system	26	4	30
. usefulness of EDI system	26	5	31
. completeness of message working up	25	6	31
. turning possibilities of EDI system	24	7	31
. covering percentage organizational functions	24	7	31
. timeliness of messages	22	9	31
. rapidity of EDI system	22	9	31
. connection with manual procedures	22	9	31
. support end-user	22	9	31
. carefulness of EDI system	21	10	31
. workability manual procedures	20	10	30
. support decision-making	19	10	29
. permissibility of message working up	19	12	31
. degradation possibilities of EDI system	18	13	31
. elasticity of EDI system	17	13	30

Table 6.8: realized and not realized static quality attributes in the EDI system design.

Static quality attributes	Completely realized in EDI system design	Not Completely realized in EDI system design	N
. suitability infrastructure	27	4	31
. internal connectivity	25	6	31
. re-usability	24	7	31
. testability	23	8	31
. external connectivity	22	8	30
. maintainability	22	9	31
. flexibility	19	11	30
. portability	17	12	29

In 10 or more cases the realization of the static quality attributes flexibility and portability were problematic in the EDI system design. Flexibility deals with the way users can expand the EDI system without changing the software. Portability deals with the easiness with which the EDI system can be transformed to another soft- and hardware environment. The results indicate that those two attributes contribute to a lower quality dimension.

Costs dimension

Figure 6.18 shows the costs dimension viz. the realized versus planned costs of the EDI system design for 28 projects. There were five categories: realized costs were equal to the planned costs (category 0%), realized costs exceed less then 10% of the planned costs (category < 10%), realized costs exceed between 10 and 50% of the planned costs (category 10 - 50%), realized costs exceed between 50 and 100% of the planned costs (category 50 - 100%), realized costs exceed more then 100% of the planned costs (category > 100%).

A higher percentage score on the costs dimension means that the realized costs exceed the planned costs of the EDI system design. In six projects (21%) of the cases the planned costs were not exceeded (category 0%). In seven projects (24%) of the cases there was an excess smaller then 10% of the planned costs (category < 10%). In eight cases (31%) the planned costs were exceeded by 10 to 50%, while in three cases (13%) the exceeding of the planned costs was running at a rate of between 50 and 100%. Finally, in four cases (14%) they were exceeded by more than 100%. For each project the planned and realized design costs are presented in appendix 2.

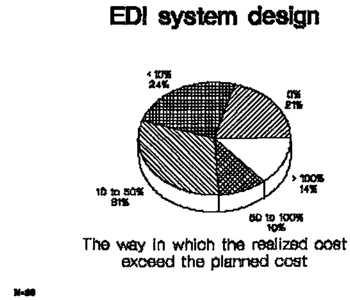


Figure 6.18: level of the costs dimension of EDI system design.

Time dimension

Figure 6.19 shows the time dimension viz. the realized delivery time of the EDI system design versus the planned delivery time for 31 EDI projects. A higher precentage score on the time dimension means that the realized delivery time exceeds the planned delivery time of the EDI system design. In only 14% percent of the cases was the planned delivery time exceeded. In 17% of the cases the excess was less than 10%. In a further 29%, the planned delivery time was exceeded by 10 to 50%. In 20% of the cases the planned delivery time was exceeded by 50 to 100%.

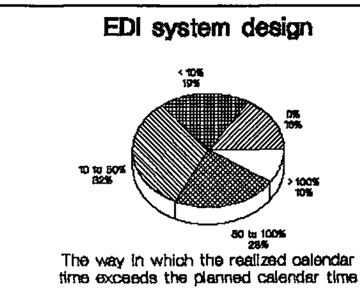


Figure 6.19: level of time dimension of EDI system design.

Then finally, in 11% of the cases, it was exceeded by more than 100%. The project managers were asked to indicate the time between the starting of the design process and the time the design process was actually finished with an EDI system design.The results are presented in appendix 2. In 7 cases it was not possible to measure the duration of the design process because the design process was not finished in the form of an EDI system design or because no accurate start or end date could be given. The average design process takes 12.9 months (N=28).

Importance of the three dimensions

In the questionnaire the respondent had to rank a score for the importance of the three dimensions of EDI system-design success : quality, costs and delivery time. The respondent could divide 100 points over these three dimensions; the higher the score, the higher the importance. Figure 6.20 shows the average level of importance for the three dimensions (N=32).

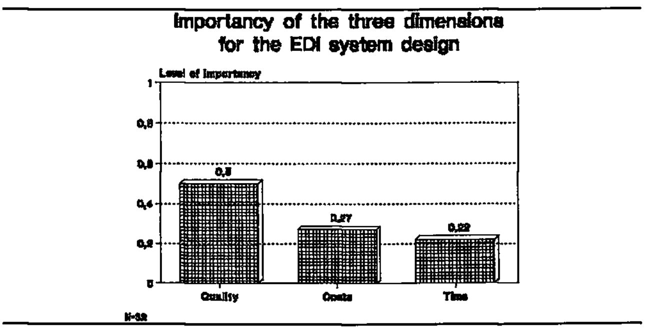


Figure 6.20: level of importance of the three dimensions of EDI system-design success.

The average ranking towards the quality dimension is 0.50, the costs dimension 0.27 and the time dimension 0.22. Quality seems to be twice as important as costs and delivery time. The costs dimension is as important as the delivery time dimension.

EDI system-design success

The level of EDI system-design success for each project was calculated by multiplying each dimension score with the average importancy ranking for each dimension, see section 5.3. The results are shown in figure 6.21.

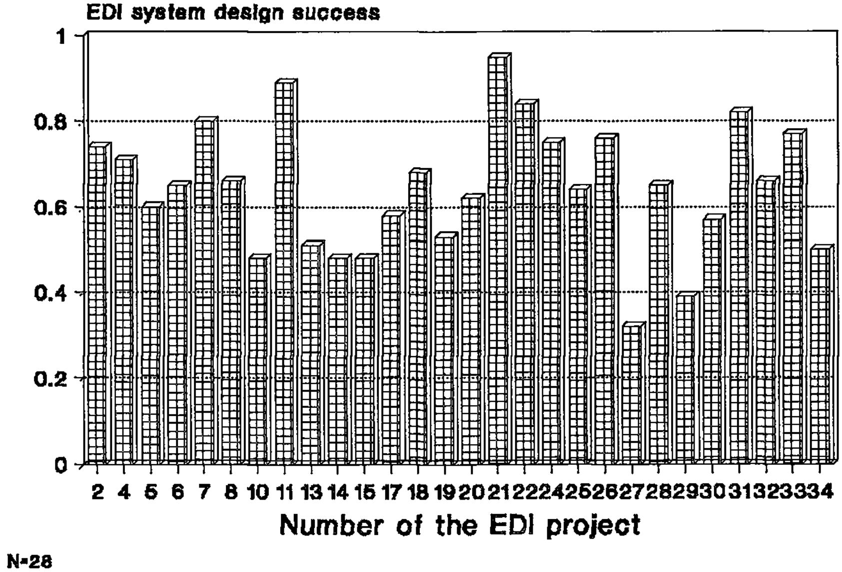


Figure 6.21: level of EDI system-design success (0 is not successful; 1 is successful).

Figure 6.21 shows the EDI system-design success for 28 EDI projects. A higher score means that the realized quality, costs and time of the EDI system design have become closer to the planned EDI system design. The average level of EDI system-design success was 0.64 on a scale of 0 to 1. EDI system-design success differentiated between 0.32 (project 27) and 0.95 (project 21) with a standard deviation of 0.15.

6.4 Results of testing the hypotheses

Introduction

In chapter 4 the research model was described with eight hypotheses. Each of the hypotheses were tested with the survey data. In this section the results of the test will be presented. In figure 6.22 the research model and the hypotheses are presented again.

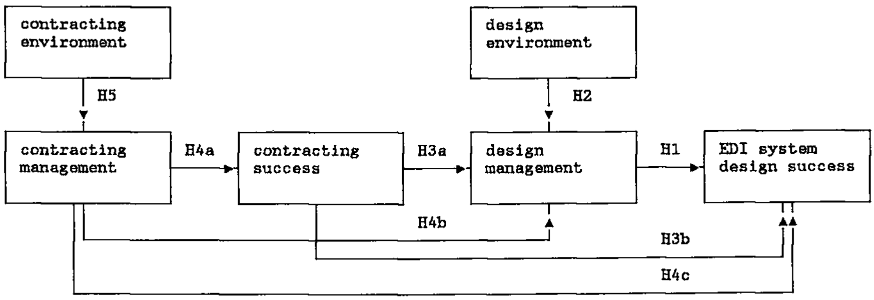


Figure 6.22: *specific research model and hypotheses (for H3b, H4b and H4c only direct relationships are drawn).*

Method of analysis and results

Each of the hypotheses will be tested successively. For each hypothesis the method and the results are presented.

H1: As the level of design management increases, the level of EDI system-design success increases.

H1 refers to the central proposition in this study that EDI system-design success is explained by the level of design management. H1 was tested by single regression analysis. For 28 cases it was possible to measure the level of design management and the level of EDI system-design success. The results are shown in table 6.9. In table

6.9 the independent variable(s), the dependent variable, the intercept and slope values in column (B), standardized intercept and slope values in column (SE B), the standardized regression coefficient (Beta), the coefficient of determination (R^2), the degrees of freedom (F), the observed significance level (p) and the number of observations (N) are presented for each hypothesis. R^2 is a measure of fit. If $R^2 = 0$, there is no linear relationship between the variables. F serves also to test how well the regression model fits. If the probability associated with the F statistic is small, the hypothesis that $R^2 = 0$ is rejected. Observed significance levels lower then 0.10 ($p < 0.10$) are satisfying.

H1 was not rejected. EDI system-design success is significantly explained by the level of design management ($F=3.99$, $p<0.10$). Level of design management explains 13.3% of the measured variation of EDI system-design success. The line which best fits the data is:

*EDI system-design success = 0.341 + 0.104 * level of design management*

The implication is that an increase in the level of design management by 1.0 causes an increase of EDI system-design success by 0.104. In figure 6.23 the relationship is visualized.

H2: As the level of stability of the design environment increases, the level of design management increases.

H2 was tested by single regression analysis. For 35 cases it was possible to measure the level of design environment and design management. The results are shown in table 6.9.

H2 was rejected. No significant relationship was found between level of stability of the design environment and level of design management ($F=0.00$, $p>0.10$). Level of design management is not explained by the level of stability of the design environment.

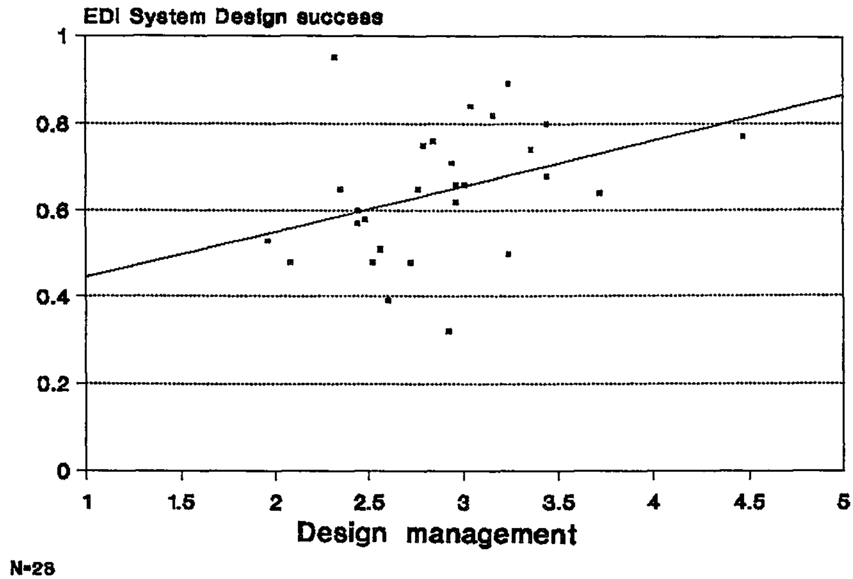


Figure 6.23: *the relationship between EDI system-design success and level of design management.*

H3a: As the level of contracting success increases, the level of design management increases.

H3a was tested by single regression analysis. For 22 cases it was possible to measure the level of contracting success and level of design management. The results of the regression analysis are shown in table 6.9.

H3a was not rejected. A significant relationship was found between contracting success and level of design management ($F=6.49$, $p=0.019$). The level of contracting success explains 24.5% of the measured variation of the level of design management.

H3b: As the level of contracting success increases, the level of design management and the level of EDI system-design success increases.

Table 6.9: results of regression analysis of the survey data for each of the hypotheses.

Independent Variable(s)	Dependent variable	B	SE B	Beta	R^2	F	p	N
H 1								
design management	EDI system-design success	.104	.052	.364	.133	3.99	.056	28
(Constant)		.341	.153					
H 2								
design environment	design management	.001	.098	.003	.000	.00	.988	35
(Constant)		2.800	.296					
H 3a								
contracting success	design management	1.612	.632	.495	.245	6.49	.019	22
(Constant)		2.196	.304					
H 3b								
contracting success	design management	1.639	.757	.454	.206	4.68	.044	20
(Constant)		2.211	.370					
design management	EDI system-design success	.069	.068	.229	.229	1.00	.329	20
(Constant)		.446	.208					
design management	EDI system-design success	.056	.079	.189	.059	.53	.595	20
contracting success		.097	.286	.089				
(Constant)		.437	.215					
H 4a								
contracting management	contracting success	.155	.052	.549	.302	8.66	.008	22
(Constant)		-.022	.165					
H 4b								
contracting management	contracting success	.155	.052	.549	.302	8.66	.008	22
(Constant)		-.022	.165					
contracting success	design management	1.612	.632	.495	.245	6.49	.019	22
(Constant)		2.196	.304					
contracting success	design management	.866	.712	.265	.366	5.48	.013	22
contracting management		.383	.201	.416				
(Constant)		1.353	.527					
H 4c								
contracting management	contracting success	.144	.045	.597	.597	9.99	.005	20
(Constant)		.021	.144					
contracting success	design management	1.639	.757	.454	.206	4.68	.044	20
(Constant)		2.211	.370					
design management	EDI system-design success	.069	.068	.229	.229	1.00	.329	20
(Constant)		.446	.208					
design management	EDI system-design success	-.033	.073	-.111	.302	3.67	.047	20
contracting management		.158	.064	.604				
(Constant)		.260	.199					
contracting success	design management	.657	.886	.182	.339	4.37	.029	20
contracting management		.398	.214	.455				
(Constant)		1.438	.543					
H 5								
contracting environment	contracting management	.126	.678	.307	.094	3.43	.073	35
(Constant)		2.709	.173					

H3b was tested by path analysis. For 20 cases it was possible to measure the level of contracting success, design management and EDI system-design success. Two paths were tested. In path 1 contracting success has an indirect effect on EDI system-design success via design management. In path 2 contracting success has a direct and an indirect effect (via design management) on EDI system-design success. The results of the path analysis are shown in table 6.9.

H3b was rejected. There is no significant direct or indirect effect of contracting success on EDI system-design success. In path 1 the direct effect of contracting success on design management is significant ($F=4.68$, $p<0.05$), but the direct effect of design management on EDI system-design success is not significant ($F=1.00$, $p>0.10$). In path 2 the direct effects of design management and contracting success on EDI system-design success are not significant ($F=0.53$, $p>0.10$).The implication is that there is no significant direct or indirect effect of contracting success on EDI system-design success.

H4a: As the level of the contracting management increases, the level of contracting success increases.

H4a was tested by single regression analysis. For 22 cases it was possible to measure the level of contracting management and contracting success. The results are shown in table 6.9.

H4a was not rejected. There is a significant relationship between the level of contracting management and contracting success ($F=8.66$, $p<0.01$). Contracting management explains 30.2% of the measured variation of contracting success. The line which fits the data best is:

*Contracting success = -0.022 + 0.155 * level of contracting management.*

This implies that the increase of the level of contracting management with 1.0 will increase the contracting success with 0.155. In figure 6.24 the relationship is visualized.

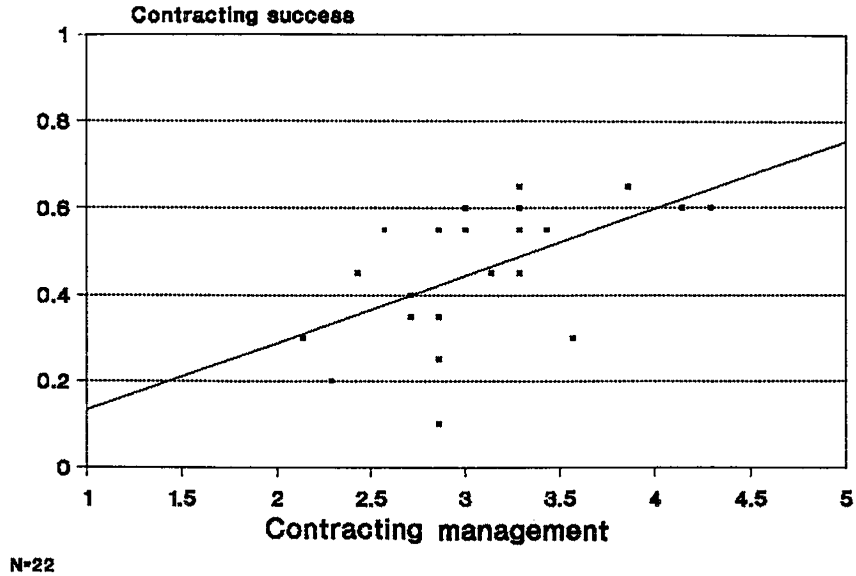


Figure 6.24: *the relationship between contracting success and level of contracting management.*

H4b: As the level of the contracting management increases, the level of contracting success and the level of design management increases.

H4b was tested by path analysis. For 22 cases it was possible to measure the level of contracting management, contracting success and design management. Two paths were tested. In path 1 contracting management has an indirect effect on design management via contracting success. In path 2 contracting management has a direct and an indirect effect (via contracting success) on design management. The results are shown in table 6.9.

H4b was not rejected. The level of contracting management has a direct and indirect effect on the level of design management. The direct effect of contracting management and contracting success is more significant ($F=5.48$, $p=0.013$) than the direct effect of contracting success on design management ($F=6.49$, $p=0.019$). So, this study opted for path 2. The direct effect of contracting management on design management is 0.265 (Beta), the indirect effect via contracting success is (the direct effect of contracting management on contracting success multiplied by the direct effect of contracting success on design management): 0.549 * 0.416 = 0.228. The total effect is the direct effect added to the indirect effect: 0.265 + 0.228 = 0.493. The level of contracting management and contracting success explains 24.3% (squared total effect) of the measured variance of the level of design management.

H4c: As the level of contracting management increases, the level of contracting success and the level of design management and the level of EDI system-design success increases.

H4c was tested by path analysis. For 20 cases it was possible to measure the level of contracting management, contracting success, design management and EDI system-design success. Three paths models were tested. In path 1 contracting management has an indirect effect via contracting success and design management on EDI system-design success. In path 2 contracting management has an indirect and direct effect on EDI system-design success. In path 3 contracting management has an indirect and direct effect on design management which has a direct effect on EDI system-design success. The results are shown in table 6.9.

H4c was not rejected. The level of contracting management has an indirect effect (via contracting success and design management) and a direct effect on EDI system-design success. The direct effect of contracting management and design management is more significant ($F=3.67$, $p=0.047$) compared with the two other paths ($F=1.00$, $p=0.329$). So, path 2 was chosen. The direct effect of level of contracting management on EDI system-design success is 0.604 (Beta), the indirect effect via contracting success and design management is ((the direct effect between contracting management and contracting success) multiplied by (the direct effect between contracting success and design management) multiplied by (the direct effect between design management and EDI system-design success)): 0.597 * 0.454 * -0.111 = -0.030. The total effect is the direct effect added to the indirect effect: 0.604 + -0.030 = 0.574. The level of contracting management, contracting success and design management explain 32.9% (squared total effect) of the measured variance of EDI system-design success.

H5: As the level of cooperativeness of the contracting environment increases, the level of contracting management increases.

H5 was tested by single regression analysis. For 35 cases it was possible to measure the level of cooperativeness of the contracting environment and the level of contracting management. The results are shown in table 6.9.

H5 is not rejected. The level of cooperativeness of the contracting environment explains the level of contracting management significantly ($F=3.43$, $p<0.10$). The level of stability of the contracting environment explains 9.4% of the measured variance of the level of contracting management.

Summary

The conclusions drawn from testing the hypothesis with regression analysis are represented in figure 6.25. The conclusions are that:

(H1) EDI system-design success is significantly explained by the level of design management;

(H2) The level of design management is not explained by the level of stability of the design environment;

(H3a) The level of design management is significantly explained by the level of contracting success;

(H4a) The level of contracting success is significantly explained by the level of contracting management;

(H5) The level of contracting management is significantly explained by the level of cooperativeness of the contracting environment.

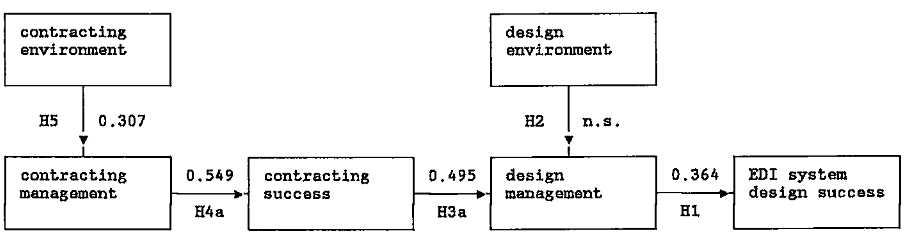


Figure 6.25: research model and the regression analysis results in terms of Beta weights (n.s. = no significant relation).

The conclusions from testing the hypothesis H3b with path analysis are summarized in figure 6.26.

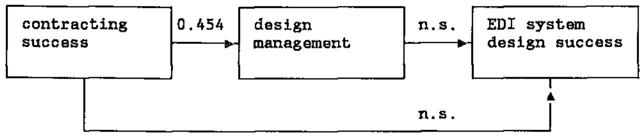


Figure 6.26 : research model and the path analysis results of hypothesis H3b in Beta weights (N=20). (n.s. = no significant relation).

The conclusion is that:

(H3b) Contracting success does not directly or indirectly effect EDI system-design success, because no significant relationship was measured between the level of design management and EDI system-design success in those cases.

The conclusions of testing the hypothesis H4b with path analysis are summarized in figure 6.27.

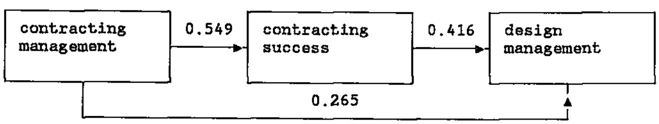


Figure 6.27 : research model and the path analysis results of hypothesis H4b in Beta weights (N=22).

The conclusion is that:

(H4b) The level of contracting management directly and indirectly significantly effects the level of design management. The direct effect is 0.265. The indirect effect is 0.549 * 0.416 = 0.228. The total effect is 0.265 + 0.228 = 0.493.

The conclusions after testing the hypothesis H4c with path analysis are summarized in figure 6.28.

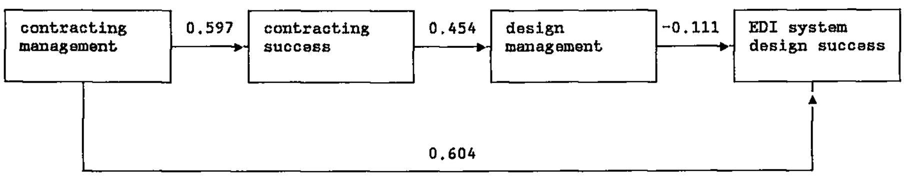


Figure 6.28 : research model and the path analysis results of hypothesis H4c in Beta weights (N=20).

The conclusion is that:

(H4c) The level of contracting management effects EDI system-design success significantly both directly and indirectly. The direct effect is 0.604. The indirect effect is 0.597 * 0.454 * -0.111 = -0.030. The total effect is 0.604 + -0.030 = 0.574.

On the basis of these results it might be worthwhile investigating the level of contracting management and the level of design management in more detail. The question is which dominant factors can be distinguished behind those two variables. In the next section these variables will be investigated in detail by using factor analysis.

6.5 Factor analysis results

Introduction

In this section the results of the factor analysis of the indicators related to the level of contracting management and the level of design management will be presented. Factor analysis is used to look for one or more new variables (named factors) - which are not observed but constructed - and which reflect all observed variables as well as possible. Factor analysis as a method is described in detail in section 5.5. Not all detailed factor analysis results are presented in this section, more detailed information can be found in Bozon and Van Heck (1992).

Factor analysis applied to contracting management

In this section the following question will be answered: which factors can be distinguished behind the indicators with regard to the level of contracting management?

Method
To determine the suitability of the data of the 7 indicators with regard to the level of contracting management, the Bartlett Test of Sphericity, the Significance Level, and the Kaiser-Meyer-Olkin Measure of Sampling Adequacy were calculated. The Bartlett Test of Sphericity was 49.158, the significance level was 0.000, and the Kaiser-Meyer-Olkin Measure was 0.546. This was an indication that the data were suitable for factor analysis. The communality of the indicators was greater than 0.3. Therefore all indicators contributed to the forming of factors. Initially three factors could be distinguished. These factors had an eigenvalue greater then 1.0 and together they explained 67.7% of the total variance within the indicators. For the interpretation of the factors the Factor Matrix was rotated by the varimax method. After the interpretation of the Rotated Factor Matrix and the reliability of the 7 indicators, the investigation turned to how to increase coefficient alpha - the reliability of the factors - by deleting certain indicators (Churchill 1979). The result was to delete the indicator 'C6 Mutual trust' because the total correlation of this corrected-item was lower then 0.0. A Principal Component Analysis was performed with 6 indicators and two factors.

Results

The result of the final Principal Component Analysis was that these 6 indicators could explain 59.6% of the variance within the indicators. The Bartlett test of Sphericity was 41.118. The significance level was 0.000 and the Kaiser-Meyer-Olkin Measure was 0.6245. The overall result is presented in table 6.10. For each of the factors, the indicators, the number of indicators, the alpha and, per indicator, the corrected item-to-total correlation (CITC) are presented. For each indicator the loadings of the indicator on the factors are presented. Only factor loadings > 0.4 and < -0.4 are important and presented in table 6.10. The total scale reliability is 0.59.

Table 6.10: results rotated factor matrix after varimax rotation with two factors and 6 indicators with regard to the level of contracting management (N=35).

Factors	Indicator		Number of ind.	Alpha	CITC*1	Factor loadings*2 of indicators F1	F2
Level of Strategic behaviour (Factor 1)	C1	Strategic planning	4	.75	.49	.75	
	C2	Costs/benefits			.47	.65	
	C5	Human resources			.62	.81	
	C7	Planning			.61	.79	
Level of dependency (Factor 2)	C3	Demonstrable benefits	2	-.02	-.01		.66
	C4	Partner choice			-.01		-.61

Total scale reliability : 0.59

*1 CITC = Corrected Item-To-Total Correlation
*2 Only factor loadings > 0.4 or < -0.4 are presented in the table.

Discussion

Table 6.10 can be discussed as follows. Before the discussion starts the reader will have to bear in mind that the results are due to decisions taken to eliminate indicators, as discussed before, and that the factor analysis deals with data reduction.

The indicators dealing with 'C1 Strategic planning', 'C2 Costs/benefits analysis', 'C5 Human resources', and 'C7 Planning' are loading high on factor 1. These indicators deal with the strategic behaviour of the organizations in the contracting process. If actors pay more attention to strategic planning, cost and benefits, human resources and planning they behave more strategically. Therefore factor 1 is called 'level of strategic behaviour'.

'C3 Demonstrable benefits' shows a high positive loading on factor 2. This indicator deals with how the benefits for each of the organizations participating are demonstrated in the contracting process. 'C4 Partner choice' is loading negatively high on factor 2. This indicator deals with the level of specification and argumentation of partner choice. Less specification of the benefits for the participants goes together with a low level of partner choice. This can be interpreted as: in those situations were there is a high level of dependency between the participating organizations the benefits are less specified and there is no specification of partner choice adaptation. For example a buyers organization (the hub) forces their suppliers (spokes) to cooperate to develop their EDI system. Therefore factor 2 is called 'level of dependency'.

Factor analysis applied to design management

In this section, the question is which factors can be distinguished behind the indicators with regard to the level of design management.

Method

To determine the suitability of the data of the 25 indicators with regard to the level of design management, the Bartlett Test of Sphericity, the Significance Level, and the Kaiser-Meyer-Olkin Measure of Sampling Adequacy were calculated. The Bartlett Test of Sphericity was 495.899, the significance level was 0.000, and the Kaiser-Meyer-Olkin Measure was 0.441. This was an indication that the data were suitable for factor analysis. The communality of the indicators was greater then 0.3. Therefore all indicators contributed to the forming of factors. Initially eight factors could be distinguished. Each of these factors have an eigenvalue greater then 1.0 and together they explain 76.6% of the total variance within the indicators. For the interpretation of the factors, the Factor Matrix was rotated by the varimax method. After the interpretation of the Rotated Factor Matrix and the reliability of the 25 indicators had been completed, ways to increase the coefficient alpha were investigated - that is the reliability of the factors was tested by deleting certain indicators (Churchill 1979). A decision was taken to delete indicators with a corrected item-to-total correlation (CITC) lower then 0.25. Four indicators were deleted. These indicators are 'H4

Human resource constraints', 'H5 Level of experience', 'H6 Representation of actors', and 'H12 Level of subcontracting'. A Principal Component Analysis was performed with 21 indicators and four factors.

Results

The result of the final Principal Component Analysis was that these 21 indicators could explain 59.2% of the variance within the indicators. The Bartlett test of Sphericity was 374.874. The significance level was 0.000 and the Kaiser-Meyer-Olkin Measure was 0.621. The overall results are presented in table 6.11. For each of the factors, the indicators, the number of indicators, the alpha and per indicator the corrected item-to-total correlation (CITC) are presented. Also, for each indicator the loadings of the indicator on the factors are presented. Only factor loadings > 0.4 and < -0.4 are important and presented. The total scale reliability is 0.87.

Discussion

The results in table 6.11 can be discussed as follows. The indicators 'H3 Resources', 'H10 Tracking', 'H11 Project control', 'H14 Definition', 'H15 Execution', 'H16 Analysis', 'H17 Control' and 'H18 Technology insertion' are loading high on factor 1. These indicators deal with the question of how to manage the design process. Therefore factor 1 is called 'level of process management'. 'H19 Technology environment' is loading on factor 1. 'H18 Technology environment' and 'H18 Technology insertion' could be related.

The indicators 'H20 Technical architecture', 'H21 Datamodelling design', 'H25 Message standardization', 'H23 Standard EDI software' and 'H25 Organizational design' are loading high on factor 2. These indicators deal with the attention which is given to certain aspects of the EDI system design during the design process. They deal with the design object. Factor 2 is therefore called 'aspects EDI system design'. 'H3 Resources' is also loading on factor 2. Resources are positively related to attention given to aspects of EDI system design.

Table 6.11 : results rotated factor matrix after varimax rotation with 4 factors and 21 indicators with regard to the level of design management (N=35).

Factors	Indicator	Number of ind.	Alpha	CITC*1	Factor loadings*2 of indicators F1	F2	F3	F4
Level of process management (Factor 1)	H3 Resources	8	.86	.59	.51	.44	.50	
	H10 Tracking			.37	.51			
	H11 Project control			.61	.73			
	H14 Definition			.75	.77			
	H15 Execution			.74	.72			
	H16 Analysis			.64	.58		.46	
	H17 Control			.79	.79			
	H18 Technology insertion			.52	.68			
Aspects EDI system design (Factor 2)	H20 Technical architecture	5	.73	.40		.61		
	H21 Datamodelling design			.31		.61		
	H22 Message standardization			.68		.67	-.41	
	H23 Standard EDI software			.63		.53	-.55	
	H25 Organizational design			.53		.70		
Relation top management (Factor 3)	H1 Policy	3	.62	.42			.68	
	H2 Oversight			.50			.72	
	H9 Planning			.38			.50	.49
Relation designer/user (Factor 4)	H7 Communication	4	.73	.50				.55
	H13 Connection decisions			.60				.77
	H19 Technology environment			.52	.44			.49
	H24 User involvement			.51				.80

Total scale reliability : 0.87

*1 CITC = Corrected Item-To-Total correlation
*2 Only factor loadings > 0.4 or < -0.4 are presented in the table.

The indicators 'H1 Policy', 'H2 Oversight' and 'H9 Planning' deal with the relation between top-management of the organizations participating and the planning of the project. Factor 3 is therefore called 'relation with Top-Management'. Typically the indicators H22 and H23 show a strongly negative loading on factor 3. An explanation could be that if more attention is given to the relation with top-management, the policy and advice given by top-management deals with decreasing the level of message standardization and standard EDI software due to strategic implications. There seems to be a positive relation between 'H3 Resources' and 'H16 Analysis' with factor 3. Resources and analysis activities are positive related to the relation between project management and top-management.

The indicators 'H7 Communication', 'H13 Connection decisions', 'H18 Technology environment' and 'H24 User involvement' all deal more or less with the relation with designers and users in the design process. Factor 4 is therefore called 'relation designers/users'. Indicator 'H19 Technology environment' is loading relatively low and deals with tools and facilities that support the design process.

6.6 Additional analysis results

Introduction

Besides the hypotheses in the research model, it is worthwhile investigating additional hypotheses with regard to the survey data. Six additional hypotheses were constructed. First the subjective contracting success will be investigated, then the subjective EDI system-design success. Third, we will elaborate on the objective EDI system-implementation success. Fourth, the results with regard to the subjective EDI system-implementation success will be discussed. Finally, the relationship between the objective EDI system-design success and the objective EDI system-implementation success will be presented. The following additional analysis results can be presented.

Subjective contracting success

One of the strengths of the research design was that the variables were measured as objectively as possible, some subjective measures were also obtained. Measurement of the level of subjective contracting success (CS_u) was one example of this. The project managers were asked to rate the contracting success on a five point Likert scale. The additional hypothesis[1] was formulated as follows:

AH1: There is a relationship between objective contracting success and subjective contracting success.

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1 A distinction is made between the (research model) hypotheses (H) and the additional hypotheses (AH).

AH1 was tested by single regression analysis. In 22 cases it was possible to measure both objective and subjective contracting success. AH1 was rejected. There was no significant relation to be measured between the objective and subjective contracting success.
It was also formulated as:

AH2: There is a relationship between subjective contracting success and the level of contracting management.

AH2 was tested by single regression analysis. For 31 cases it was possible to measure both variables. AH2 was rejected. There was no significant relationship to be measured between the subjective contracting success and the level of contracting management. A subjectively perceived successful contract does not correspond with a higher level of contracting management.

Subjective EDI system-design success

The subjective EDI system-design success (EDS_u) was measured. The project managers were asked to rate the EDI system-design success on a five point Likert scale. The additional hypothesis was formulated as follows:

AH3: There is a relationship between objective EDI system-design success and subjective EDI system-design success.

AH3 was rejected. There was no significant relation to be measured between the objective and subjective EDI system-design success. A subjectively measured successful EDI system design does not correspond with an objectively measured successful EDI system design.

The following was also hypothesized:

AH4: There is a relationship between subjective EDI system-design success and the level of design management.

AH4 was tested by single regression analysis. In 35 cases it was possible to measure subjective EDI system-design success and the level of design management. AH4 was not rejected. A significant relationship was measured between the subjective EDI system-design success and level of design management ($F=3.37, p=0.075$). Level of design management could explain 9.2% of the measured variance of the subjective EDI system-design success. A higher level of design management is related with a more, subjectively perceived, successful EDI system design.

EDI system-implementation success

In 31 EDI projects the implementation process resulted in an implemented EDI system. In the other 4 cases, no EDI system was implemented. This is represented in figure 6.29.

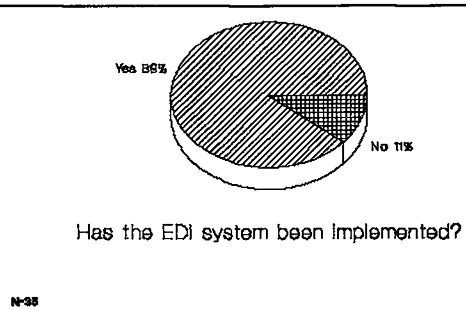

Figure 6.29 : implementation of EDI System

Just like the EDI system-design success, there are three dimensions for the (objective) EDI system-implementation success; planned versus realized quality, costs and delivery time of the implemented EDI system. First these three dimensions will be discussed.

Quality dimension

A higher score on the quality dimension means that the realized quality of the implemented EDI system became closer to the planned quality. The average quality dimension was 0.75 on a scale of 0 to 1. The quality dimension differentiated between 0.37 and 1.00 with a standard deviation of 0.18. Just like with the EDI system design, to make the scores of these dimensions comparable, the absolute quality scores were turned into ordinal scores. This is showed in figure 6.30.

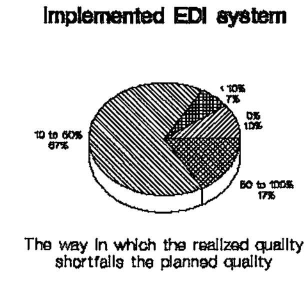

Figure 6.30: level of the quality dimension of the implemented EDI system.

The figure shows that there are 3 projects which realized their planned quality for 100%, in 2 projects less then 10% of the planned quality attributes were not realized (category < 10%). Here too, most of the projects (20) ranged between 10 to 50% not realized quality attributes if compared to those planned, while 5 projects were in the category of 50 to 100%.

Costs dimension

Figure 6.31 shows the planned costs versus the realized costs for 24 EDI projects of the implemented EDI system. In only 26% percent of cases were the planned costs not exceeded. In 34% of cases the planned costs were exceeded by between 10 to 50%. In 3% of the cases the planned costs were exceeded by between 50 and 100%, and in 6% of the cases there was an excess of more than 100%.

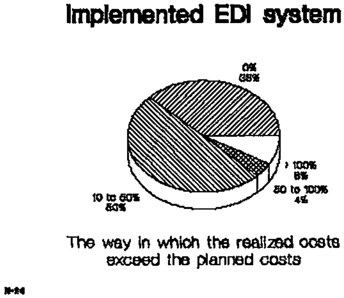

Figure 6.31: level of the costs dimension of the implemented EDI system.

Time dimension

Figure 6.32 shows the realized delivery time of the implemented EDI system versus the planned delivery time, for 24 EDI projects. In 29% percent of cases the planned delivery schedule was not exceeded. In 9% of cases it was exceeded by less than 10%. Further, in 23% of cases the planned delivery time was exceeded by 10% to 50%. In 6% of cases the planned delivery time was exceeded by 50 to 100%, and in 11% of cases it was exceeded by more than 100%.

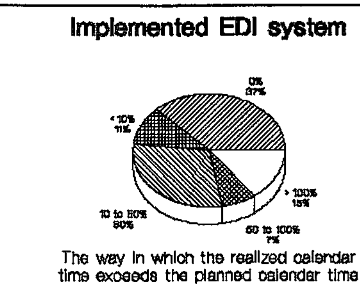

Figure 6.32: level of the time dimension of the implemented EDI system.

Importance of the three dimensions

Just like with the EDI system design, the respondent had to rank a score for the importance of the three dimensions of EDI system-implementation success: realized versus planned quality, costs and delivery time. Again, the respondent could divide 100 points over these three dimensions; the higher the score, the higher the importance. Figure 6.33 shows the average level of importance for the three dimensions (N=29). As the figure shows, the dimension quality is 0.54, the dimension cost 0.27 and the dimension time 0.19.

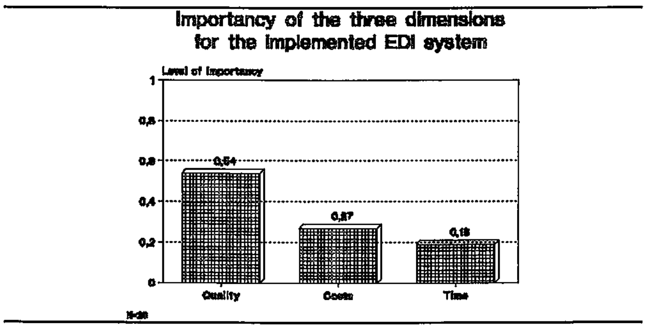

Figure 6.33: level of importance of the three dimensions of the EDI system-implementation success.

EDI system-implementation success

In 7 cases, one or more dimensions could not be specified. Therefore in 24 cases it was possible to indicate the EDI system-implementation success (see figure 6.34). A higher score means that the realized quality, cost and time of the implemented EDI system grew closer to the planned implemented EDI system. The average level of EDI system-implementation success was 0.69 on a scale of 0 to 1. EDI system-implementation success differentiated between 0.29 and 0.92 with a standard deviation of 0.17.

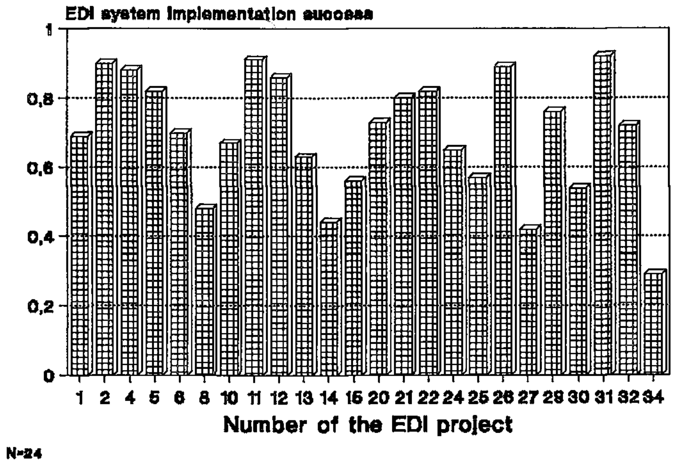

Figure 6.34: level of EDI system-implementation success (0 is not successful; 1 is successful).

Subjective EDI system-implementation success

The subjective EDI system-implementation success was measured. The project managers were asked to rate the EDI system-implementation success on a five point Likert scale. It was hypothesized:

AH5: There is a relation between objective EDI system-implementation success and subjective EDI system-implementation success.

AH5 was tested with single regression analysis. For 24 cases it was possible to measure both variables. AH5 was rejected. There was no significant relation measured between the objective and subjective EDI system-implementation success. The subjectively measured successful implemented EDI system does not correspond with an objectively measured successfully implemented EDI system.

Relation EDI system-design success and EDI system-implementation success

In 31 cases the EDI system was implemented. In 24 cases it was possible to measure the level of success of the implemented EDI system in terms of planned versus realized quality, costs and delivery time of the implemented EDI system. In 22 cases it was possible to measure both objective EDI system-design success and objective EDI system-implementation success. The additional hypothesis was formulated as:

AH6: There is a relationship between EDI system-design success and EDI system-implementation success.

AH6 was not rejected. There was a significant relationship between the measured (objective) EDI system-design success and the measured (objective) EDI system-implementation success of 0.665 ($F=15.8$, $p<0.001$). EDI system-design success explains 44.2% of the measured variation of the EDI system-implementation success. A successful EDI system design corresponds with a successfully implemented EDI system.

6.7 Summary

The following two questions were answered in this chapter:

. What factors are responsible for the success or failure of the design of an EDI system and how are these factors related to the success or failure of the design of an EDI system?

- In 32 of the 35 projects investigated the design process resulted in an EDI system design. In the other cases no EDI system design could be specified. In 4 cases one of the EDI system-design success dimensions (quality, costs, delivery time) could not be specified by the respondent. The average level of EDI system-design success was 0.64 on a scale of 0 to 1. None of the EDI projects reported an EDI system-design success level of 1. It means that none of the EDI projects reached their objectives in terms of planned quality, costs and delivery time of the EDI system design.

Analysis of the Survey Data

The obtained data were tested using multi-variate analysis methods. The results are as follows.

(H1)	EDI system-design success is significantly explained by the level of design management;
(H2)	The level of design management is not explained by the level of stability of the design environment;
(H3a)	The level of design management is significantly explained by the level of contracting success;
(H3b)	Contracting success does not directly or indirectly effect EDI system-design success;
(H4a)	The level of contracting success is significantly explained by the level of contracting management;
(H4b)	The level of contracting management directly and indirectly effects the level of design management significantly.
(H4c)	The level of contracting management effects directly and indirectly EDI system-design success significantly.
(H5)	The level of contracting management is significantly explained by the level of cooperativeness of the contracting environment.

Factor analysis of the level of contracting management shows that two factors could be distinguished. These two factors explain 59.6% of the variance within the 6 indicators. The total scale reliability was 0.59. The first factor deals with the level of strategic behaviour of actors within the contracting process. The second factor deals with the level of dependency between the organizations participating.

Factor analysis of the level of design management shows that four factors could be distinguished. These four factors explain 58.2% of the variance within the 21 indicators. The total scale reliability was 0.87. The first factor deals with the level of process management of the design process. The second factor deals with the level of attention given in the design process to aspects of the EDI system design. The third factor deals with the strength of the relationship between the EDI project management and top-management of the organizations. The fourth factor deals with the strength of the relationship between the designer(s) in the EDI project and the prospective user(s) of the EDI system of the organizations.

Additional analysis results are as follows. No significant relation was measured between objective and subjective contracting success. Also, no significant relationship was measured between subjective contracting success and level of contracting management. No significant relation was measured between the subjective and objective EDI system-design success. A significant relationship was measured between subjective EDI system-design success and the level of design management. The level of design management explains significantly the level of subjective EDI system-design success. For 24 cases it was possible to measure EDI system-implementation success. The average level of EDI system-implementation success is 0.69. In 22 cases it was possible to measure both EDI system-design success and EDI system-implementation success. There is a significant relationship between those two variables. EDI system-design success explains significantly EDI system-implementation success.

The analysis of the survey data provides new relevant questions related to the problem stated. There are three groups of questions. The first group deals with questions concerning elements of the research model which could not be (significantly) explained. Those questions are:

- Why does the level of cooperativeness of the contracting environment explain only a small amount of the measured variation of the level of contracting management?
- Why does contracting success (level of specification of the contract) fail to effect, directly or indirectly, EDI system-design success?
- Why does the level of stability of the design environment not explain the measured variation of the level of design management?
- Why does the level of design management only explain a small amount of the measured variation of EDI system-design success?

The second group deals with questions concerning elements of the research model which could be significantly explained and could be investigated in detail. For example questions like:

- Why do the factors 'level of strategic behaviour' and 'level of dependency' reflect strongly the level of contracting management?

- Why do the factors 'level of process management', 'aspects of EDI system design', 'relation with top management', 'relation designers/users' reflects strongly the level of design management?

The third group deals with questions concerning elements which are indirectly related to the research model and which arose from the additional analysis. For example questions like:

- Why is there no significant relationship between subjective and objective contracting success and subjective and objective EDI system-design success?
- Why does EDI system-design success significantly explain EDI system-implementation success?

It was decided to investigate the first group of questions in more detail, because those questions are related to weaknesses in the research model. Answers to these questions can strengthen the research model. The second group of questions was not investigated because results could be proven significantly and a further investigation could come up with (only) detailed results. The third group of questions was not investigated because those questions are a little too far removed from the central problem.

The first group of four questions will be explored by a case study of one EDI project. The research approach and material will be discussed and the results will be presented and analyzed in chapter 7.

7 CASE STUDY OF THE EDI FLOWER PROJECT

7.1 Introduction

The results of testing the research model by a quantitative approach has left us with four questions. Those questions were:

- Why does the level of cooperativeness of the contracting environment explain only a small amount of the measured variation of the level of contracting management?
- Why does contracting success not effect EDI system-design success either directly or indirectly?
- Why does the level of stability of the design environment not explain the measured variation of the level of design management?
- Why does the level of design management explain only a small amount of the measured variation of EDI system-design success?

In this chapter those questions will be answered following a qualitative path. A specific EDI project will be explored by means of a case study. In section 7.2 the four questions will be investigated in greater detail. The research approach and research materials will be discussed in section 7.3. The EDI Flower project was chosen for a detailed investigation using the case study approach. In section 7.4 the history of the EDI Flower project will be briefly presented. Section 7.5 will describe what actually happened in the EDI Flower project based on the variables of the research model. In sections 7.6 to 7.9 answers for the four questions previously presented will be formulated.

7.2 Exploration of four questions

In this section the four questions will be investigated in more detail. We are returning to the construction of a theory. Constructs, propositions, variables and hypotheses were identified. The four questions deal with the argumentation of those elements and the relationship between them. In general, the following answers could be given to each of these questions. The possible answers are formulated in the form of case hypotheses (CH)[2]. There are four case hypotheses possible for *each* question:

CH1: In reality there is no relationship between the constructs (mentioned in that specific question);

CH2: In reality there is a relationship between the constructs (mentioned in that specific question) but the variables are not refined in such a way that they are related to the construct;

CH3: In reality there is a relationship between the constructs (mentioned in that specific question) and the variables are refined in a way that they are related to the construct but the indicators are not related to the variables;

CH4: In reality there is a relationship between the constructs, variables and indicators, but the items belonging to the indicators were not measured in the proper way;

First question

The first question deals with the relation between level of cooperativeness of the contracting environment and the level of contracting management. The variable level of cooperativeness of the contracting environment e.g. the sector was indicated by the indicators 'competition', 'growth cycle', 'product/market cycle', 'bargaining power', 'branch/EDI organization'. Only the last indicator was used based on internal consistency arguments. Survey results showed there was a significant relationship between level of cooperativeness of the contracting environment (indicated by existence and involvement of branch or EDI organizations) and the level of contracting management, see section 6.4. It provides us with an argument for

2 We distinguish case hypotheses (CH) from hypotheses (H) and additional hypotheses (AH).

rejecting case hypothesis 1 for the first question. There seems to be a relationship between contracting environment and contracting management. But this relationship is difficult to pinpoint, operationalize and measure. Recently meta-research has been reported about survey research results in the study of management information systems (MIS) by Kraemer and Dutton (1991). They reviewed 98 articles. It is interesting to notice that the framework they used was an organization - environment framework. The organization is the central focus. Outside the organization they distinguish the external environment. Inside the organization they distinguish the organizational environment, the IS user environment, the IS development environment and the IS operations environment. They reported that in the investigated articles the external environment was ignored, partly because national and cross-national surveys, which would introduce variance at that level were rarely used (Kraemer and Dutton 1991:6). Zmud and Boynton (1991) reported on survey measures and instruments in MIS, using the same framework as Kraemer and Dutton (1991). They investigated 27 articles on survey instruments. Within those 27 articles no specific measuring instrument dealt with the external environment and just one article dealt with the organizational environment (on work and social relations (Dolan and Tziner 1988)). Zmud and Boynton (1991:152) were optimistic when they reported that the lack of scales for the external and organizational environments is not viewed with too great concern because well-developed instruments from the organizational behaviour and organizational theory (OB/OT) literature exist for many of these constructs. But they only reported on one article (Jones 1987) dealing with the external environment construct (Zmud and Boynton 1991:166). More articles were reported on the organization/group environment construct. In general, one can conclude that other researchers have not investigated the external environment intensively. So, from recent literature no new variables could be used. Related to question 1, the second, third and fourth case hypothesis will be investigated. Are there other useful variables, are there other indicators which reflect the level of cooperativeness, and are there better ways of measuring the indicators?

Second question

The second question deals with the relationship between contracting success and EDI system-design success. This relationship was not found to be significant. On the contrary, a significant relationship was found between contracting success and the level of design management on the one hand and the level of design management and EDI system-design success on the other. From these results one would expect a significant relationship between contracting success and EDI system-design success, but that was not the case. The construct contracting success was refined in the variable level of specification of the contract which was further refined into indicators in the form of the existence of 20 aspects in the contract. It was reported from the survey results that:

- In 22 of the 35 cases a cooperation contract was specified;
- In those 22 cases those cooperation contracts were not very specified (average level of specification 0.46 on a range between 0 (not specified) and 1 (very specified));
- That in those 22 cases the aspects related to the EDI system-design success (quality, costs and time) were not specified in almost 30% of the cases.

Indications were found in the survey that the variables are not directly related. This was due to the fact that there were no cases in the group of investigated EDI projects which represented a highly specified contract. Case hypotheses 1 and 2 were rejected. It was decided to investigate case hypothesis 3 and 4 for the second question. Are there other indicators which reflects the level of specification of the contract or are there better ways of measuring it?

Third question

The third question deals with the relation between the level of stability of the design environment and the level of design management. The variable level of stability of the design environment was indicated by the indicators 'automatization level', differences in automatization levels', 'organizational changes', 'average size partners', and 'legal/fiscal aspects'. The last indicator was not taken into account due to internal consistency arguments. Survey results show there was no significant relationship measured between the level of stability of the design environment and the level of design management. For this question it was decided to investigate all four hypotheses. Is there a relationship between the constructs, are there other useful variables, are there other indicators, and are there better ways of measuring the indicators?

Fourth question

The fourth question deals with the relationship between the level of design management and EDI system-design success. Level of design management was indicated by 25 indicators. EDI system-design success was measured by indicating the planned versus realized quality, costs and delivery time of the EDI system design.

The survey results reported a significant relationship, but the level of design management could only explain 13.3% of the measured variation of EDI system-design success. Case hypothesis 1 could therefore be rejected. It was reported from the survey results that:

- In 22 cases the aspects related to the EDI system-design success (quality, costs and time) were not specified in the cooperation contract in alsmost 30% of the cases;
- In 28 cases it was possible to measure level of design management and EDI system-design success, because in the other cases the planned quality, costs and time were specified in a different way;
- The specification of the planned and realized quality of the EDI system design was in some cases difficult to obtain, because in most cases the planned quality of the EDI system design was barely specified. One could only specify which quality attributes were completely or not completely realized in the EDI system design.

These results indicate that it might be worthwhile to investigate how to measure EDI system-design success in a different way. It became clear that by measuring planned versus realized dimensions one could not identify those situations in which the planned dimensions had a low ambition level and therefore could easily be reached. Case hypothesis 2 could be rejected. It was decided that hypotheses 3 and 4 would be investigated for question 4. Are there other other indicators which reflects level of design management and EDI system-design success, and are there better ways of measuring the indicators?

7.3 Research approach and material

To chose a research approach is like rowing between Scylla and Charybdis. The strength of the survey is due to the (statistical) generalization of the results. Surveys are not well suited to capturing the nuances and subtle patterns of human behaviour that often form the core of qualitative research (Kraemer and Dutton 1991:12). In this chapter four questions will be investigated in an explorative way. A qualitative approach seems to be appropriate. This study follows Hammersley (1989), who focused on the dilemma of the qualitative method. In sociology, but not only there, a debate went on about the role of case study and statistics. It was decided to choose the argumentation that these are complementary, as Hammersley (1989:95) argued, statistical method provides the basis for the identification of typical cases to be studied in depth, and for the subsequent generalization of findings. There are several possible qualitative approaches for theory testing and extension, like case study, descriptive/interpretive research, and action research (Galliers 1990). The last two approaches are interpretivist approaches whose assumptions are different from the scientific approaches like that of the survey (Lee 1989; Galliers 1990). Therefore the case study was chosen. Case study research is defined by Yin (1984:23) as:

> *'An empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.'*

Case study

The case study method is widely used in information systems research, see for a good example of this, Markus (1983). In case study research, the object is investigated in the real-life context. In most situations this will not be a snap-shot of one moment, like the survey, but we will follow the process instead. Within the case study it is possible and desirable to use several methods like interviews, document analyses, observations. Galliers (1990:162) states that:

> *'The strength of the case study approach is that it enables the capture of 'reality' in considerably greater detail (and the analysis of a considerably greater number of variables), than is possible with any of the above (Laboratory Experiments, Field Experiments, Surveys (EH)) approaches.'*

Its weaknesses, according to Galliers (1990), include:

- Its application is usually restricted to a single event/organization;
- It is difficult to acquire similar data from a statistically meaningful number of similar organizations;
- It makes generalizations from individual case studies;
- Its lack of control of individual variables;
- The difficulties encountered in distinguishing between cause and effect;
- The different interpretations which can be placed on observations by individual researchers/stakeholders'.

One way of overcoming those weaknesses, as Yin (1989) argued, is to pay attention to the research design. A good research design should force an investigator to articulate the objectives and questions to be studied and show how the method to be pursued bears on these objectives or questions; link the objectives and questions to the basic unit of study; identify the critical evidence that will support the major hypotheses of the study; and stipulate the relevant techniques for analysing the evidence; so that the questions of initial interest are addressed in a critical manner. It should also provide clear directions for one of the most vexing problems of case studies - generalizing from the results to other cases. Research design will be discussed in detail.

Research design

The objective of this part of the study is to gain greater insight into the relation between:

- The level of cooperativeness of the contracting environment and the level of contracting management;
- Contracting success and EDI system-design success;
- The level of stability of the design environment and the level of design management;
- The level of design management and EDI system-design success.

The objective and questions indicate that we have to deal with the process of inducting theory using case studies (Eisenhardt 1989). In this study the unit of analysis is the EDI project. An EDI project involves the participation of several organizations. Within the unit of analysis this study is particularly interested in previously specified constructs. In this research two different methods were used within the case study: interviews and analyses of documents. Therefore the principle of triangulation could be applied. Triangulation can be defined as the use of different methods to overcome the weaknesses of one method and it also compares the results obtained by the different methods.

Generalization

An appropriately developed theory not only facilitates the data-collection phase of a case-study, but also reflects the level at which generalization of the case study results will occur. This is termed analytical generalization which may be contrasted (and commonly confused) with statistical generalization (Yin 1989). In analytical generalization, a previously developed theory is used as a template to compare the empirical results of the case study. It is appropriate with both single and multiple case studies. The contrasting, and inappropriate, manner of generalizing assumes that the selected cases are some sample of a larger universe of cases. Such sampling criteria will usually be irrelevant in designing case study research and should be avoided (Yin 1989).

EDI Flower project

The following criteria were used to choose the research material:

- A restricted number of organizations had to be involved in the project;
- The organizations had to be based in the Netherlands;
- The project had to have a finished design process;
- It was essential to be able to interview the project manager and obtain relevant documents from the project.

The EDI Flower project met these criteria. In the EDI Flower project growers, auctions, and wholesalers of cut flowers and pot plants are participating in the development and implementation of one EDI system for all member organizations. In the period August 1990 - August 1991 the researcher was connected with the project as a working group leader of one of the working groups known as the reference working group. In August 1991, this group's final report was presented and approved by the steering committee. A year after the researcher left the project the case study was executed.

Interviews

The project manager of the EDI Flower was interviewed. First he was interviewed with the help of the questionnaire used in the survey, see appendix 1. In the second part of the interview 'open' questions were introduced on the issues related to the four questions which arose as a result of the survey results.

Analyses of documents

The following documents were analyzed. General reports of the history of the EDI Flower project, official meeting documents of the policy group, of the steering group, of the different working groups. Also products, in the form of reports from the different working groups, were investigated. General reports on the horticulture sector were also reviewed.

Method of data analysis

The research method resulted in a large amount of data. There seem to be numerous techniques for qualitative data analysis. Among them are analytical induction, hermeneutics, ethnography, participant observation, content analysis, and grounded theory. Markus (1991) compared tree analysis methods: analytical induction, grounded theory and content analysis. The purpose of analytical induction is to generate propositions, theories or hypotheses for testing. Its primary analytic strategy is analysis and data reduction. Grounded theory is to generate theory and to support practice. Its primary analytic strategy is synthesis and capturing complexity. The purpose of content analysis is to make valid inferences from texts. Its primary analytic strategy is sorting and counting.

This study used analytic induction as a qualitative data analysis technique because our purpose is to explore, previously specified, hypotheses. These hypotheses will not be tested but explored inductively by analysis and data reduction. Analytic induction is a technique for categorizing and coding qualitative data (e.g. interview notes, open ended responses to questionnaire items, notes from observations in natural settings, archival documents and other forms of textual data) (DeGross et al. 1991:390). The data were analyzed by using an analysis scheme which was deduced from the research model as presented in chapter 4. The analysis scheme is presented in figure 7.1. In this figure, the horizontal dimension represents the independent variable and the vertical dimension represents the dependent variable. For these four relationship we are looking for different variables, different indicators or different items.

		contracting management	design management	EDI system design success
contracting environment	. different variables . different indicators . different items	(1)		
contracting success	. different indicators . different items			(2)
design environment	. different variables . different indicators . different items		(3)	
design management	. different indicators . different items			(4)

Figure 7.1: analysis scheme of the case study.

Elements in the documents and interviews were arranged by the number in the analysis scheme representing the specific relationship.

7.4 History of the EDI Flower project

In this section a historical overview of the EDI Flower project will be presented.

Initiative

The EDI Flower project has evolved around two flower-auctions in the Dutch horticultural sector. Horticulture is a major economic activity in the Netherlands. Cut flowers are the strongest export product in the country. Almost 75% of the world export of cut flowers comes from the Netherlands. Exports have increased from 800 million guilders in 1975 to 3,7 billion guilders in 1991. In 1991 49% of the export went to Germany, 14% to France, 10% to Great Britain, 4% to Italy, 4% to Switzerland, 3% to the United States and 16% to different countries like Japan. Important cut flowers are carnations, roses, fresias, daisies, chrysanthemums, and lilies. There are 5500 growers in the horticultural sector. The flower auctions in the Netherlands are cooperatives owned by the growers. A grower has the responsibility of sending his flowers to his auction. The growers do not have to worry about the market to sell their products. They can concentrate on the quality, costs and delivery time of their cut flowers.

In 1988 the two biggest flower auction concerns (Flower Auction Aalsmeer and Flower Auction Holland[3]) analyzed future developments with regard to the marketing of flower products. They became aware of the fact that:

- The speed of the central auction process is an important price-setting element. The speed of distribution is also important in distributing fresh flower-products daily around the world;
- The quality and reliability of the product data is of importance for the logistical function and for marketing. A yearly increase in the supply of flower products by 10% leads to the conclusion that in the future it might be worthwhile

[3] In 1988 the name was Flower Auction Westland. In 1991 Flower Auction Westland and Flower Auction Berkel merged and formed Flower Auction Holland.

investigating the possibility of selling the products by auction without the physical presence of the product. Products will then be sold on the basis of information on the product (price, quantity, quality).

The need for standardized and automatic message interchange in the horticultural sector became evident. EDI could play a role in that respect. EDI was introduced in the horticultural sector by Flower Auction Aalsmeer (FAA), Flower Auction Holland (FAH), the Tradegroup Wholesale in Floriculture Products (TWF) and the wholesalers Baardse and Zurel.

Introduction

The first schemes for introducing EDI in the horticultural sector appeared at the end of 1988. In the introduction process the initiators (FAA, FAH, TWF, Baardse, Zurel) were supported by GE Information Services (GEIS). At the end of the introduction process an introduction plan was presented. In this report the EDI Flower project was defined. Two phases were distinguished: The EDI-pilot project (phase A) and the EDI-broadening project (phase B).

Pilot

In the pilot project an EDI pilot system was developed between growers, auctions, wholesalers/exporters and TWF. The objective of the pilot project was:

> *'To realize an operational model of electronic data interchange, of the type which will provide sufficient concrete information for testing whether an integral EDI network for the horticulture sector is feasible. The pilot project must provide the answer, within the planned term, to the question of where benefits could be obtained, how much effort is needed for its preparation and implementation and what the costs are in the preparation and operational phase.'*

Partners and messages were selected. It was decided to select the following messages:

- The supply letter which is sent by the growers and received by the auctions FAA and FAH. Every container with flowers and plants which is sent to auction is accompanied by a supply letter. Printed on the supply letter is data concerning the parcel and grower. Big auction houses receive 15,000 supply letters every day. The grower can prepare the supply letter automatically. The data are typed in manually by the auction houses.

- The transaction message which is sent by the auctions FAA and FAH and received by the two wholesalers/exporters Baardse and Zurel. When a wholesaler/exporter buys a parcel it is accompanied by a transaction message. The data on the transaction message is about the product and the buyer. After receiving the (paper) message the buyer will type the data in its own sale information system.
- The export message which is sent by the wholesalers/exporters Baardse and Zurel and received by the tradegroup TWF. The exporters are obliged to send a copy of the invoice to the tradegroup TWF. Also a copy of every paid invoice has to be sent to the tradegroup. They receive 1.2 million messages every year.

For each of the three messages a sub-project was developed and executed during the period April to October 1989. In October the pilot project was evaluated. The evaluation took place by investigating the progress of each sub-project, the determination of the message definition, the learning effect of technical aspects, and the expected operational costs and projected yield.

The general conclusion was that the realization of EDI was not held back by technology but by politics and money. Political problems arose when parties have different interests in defining message standards. For a successful implementation of EDI the receiving party should play the leading role. In general the receiving party gets the greatest cost reduction. It is of importance that the receiving party plays the leading part in the definition and determination of the message content and message standard.

With regard to message definitions it was decided to define these on the basis of the analysis of the data models and information needs of the receivers. This was the case with the introduction of the export message where TWF was the only receiver and had sufficient power and money. With the definition of the auction bill, too much attention was paid to the wishes of the senders and too little to the receivers. The result was a hybrid message, which did not contain the advantages of a 'real' standardized auction bill and was not closely linked to the needs of the receivers. The supply letter does not even get that far.

With regard to technology for the auctions, it was hard to explain why messages which were sent to a wholesaler in the same (auction) building were first sent to a computer outside. It seemed that local communication computers were more appropriate than the mail-box system of an external network supplier. It was suggested that local systems in FAA and FAH with a connection to each other and to (inter)national (EDI) networks be developed.

With regard to costs, it was concluded that in some cases the costs would be prohibitively high. Using their own local networks costs would probably be lower.

In the evaluation the following recommendations were made:

. The pilot project should be finished;
. The activities, described in the introduction phase, should be continued. Two working groups would have to specify message exchange between auctions and wholesalers and between auctions and growers. The possibilities of local network facilities in the auctions would have to be investigated;
. A platform for message standardization in the horticulture sector would have to be set up;
. An external EDI expert should be retained who, supervised by the platform, could:
  - make a plan for the organizational structure of the platform;
  - make a concrete activity plan for the platform;
  - execute the activities described in the annual plan.

Broadening

The recommendations were followed by activities to broaden the process, these were carried out between November 1989 and April 1990, and executed by Twijnstra Gudde, a Dutch consultancy organization. The broadening process was initially defined by GEIS and the objective was to broaden the concerns of the different parties in the horticulture sector. The result of the broadening process was a plan for an 'EDI Flower Platform'. The objective of the 'EDI Flower Platform' was:

> '*To develop and maintain a coherent set of standardized messages for use in EDI in the horticulture chain.*'

The plan described:

. The approach of the EDI Flower project, as a base for a detailed description of the sub projects;

- The setting up of the organization which would take care of the development and maintenance of the message set, which would coordinate the tuning of the different subprojects in the message definition phase, and would take care of the tuning with relevant message definitions outside the horticultural sector.

The approach which was chosen could be characterized as project-oriented. Phases and success- and failure factors were distinguished. Among those factors were: the creation of a win-win situation for every participant, a Nolan balance between the organizations, a drawing role from the top managers, the availability of a budget, the involvement of every party, and reasonable objectives. Also attention must be paid to making interests visible for the organizations and to the public relations aspect to make the project visible to the sector.

In the organization three levels were distinguished: the policy level, the management level and the execution level. The 'EDI Flower Platform' took place at policy level. Participants of organizations in the horticultural sector were involved in the Platform. At management level a steering group and a project leader were proposed. One representative of FAA, FAH and TWF respectively were involved. In this group an external project manager was selected and appointed for daily project management activities. At the execution level four working groups were proposed. The plan recommended the following steps be taken: agreement on the proposed approach, efforts be made to secure a budget, the appointment of a project manager, manning of working groups and that employees of Wageningen Agricultural University be asked to coordinate the development of the reference model in working group four.

7.5 Description of the EDI Flower project

In this section a description of the EDI Flower project will be presented with the help of the variables from the original research model. The objective was *not* to test the research model out on this case, that had already been done in the survey, the objective was to describe the EDI Flower project. The description is presented by using interview data and project documents.

Contracting environment

The level of cooperativeness of the contracting environment e.g. the sector was indicated by the 'level of competition', 'stage of growth cycle', 'stage of product/market cycle', 'bargaining power' and 'branch/EDI organization'. For theoretical and internal consistency reasons only the last indicator was used in the survey research. These related indicators were used to describe the level of cooperativeness of the contracting environment related to the EDI Flower project.

Level of competition
The first indicator of the level of cooperativeness deals with the level of competition within the sector. In the case study it was clearly noticed that the start of the introduction of EDI in the horticultural sector was related to the fact that in the competition with other auctions two factors play an important role:

- The speed of the central auction process is an important price-setting element. The speed of distribution is also important in the daily distribution of fresh flower products around the world;
- The quality and reliability of the product data is of importance for the logistical function and for marketing.

This study indicated that within the Dutch horticulture sector a process of concentration was going on, especially among the auctions, wholesalers, shipping agents and retailers. Those bigger organizations are more dependent on the quality and reliability of the product data. In the case study, the dominant organizations of the Dutch horticultural sector initiated and participated in the EDI Flower project.

Stage of growth cycle
It should be noted that the sector is in the expansion phase of the growth cycle. It was reported that the annual increase of flower products was 10%. This expansion stimulated the auctions to look for ways of using telematics and EDI for the running of their business. They were looking for ways to auction flower information instead of the flower itself.

Stage of product/market cycle

It was reported that the messages to be designed in the EDI Flower project were related to new services which were provided to growers and wholesalers by the auction houses. Therefore it was indicated that these services were in the development phase. Equally, the indicator stage of the product/market cycle was difficult to measure in the EDI Flower project because the EDI Flower project deals with message exchanges which are related to different product/market combinations. There is no clear and strong relationship in terms of special products for special markets.

Bargaining power

In this project it became clear that the organizations were the front runners in the Dutch horticultural sector. The two auctions and the two wholesalers participating are big, in terms of their volume of business and size. The Tradegroup (TWF), representing all wholesalers, plays a leading role. As far as power is concerned, there is an equilibrium between these players. It is interesting to reflect on the relation between wholesalers and retailers: last year power shifted from the wholesaler to the retailer. The latter is closer to the consumer and is therefore able to identify consumers needs at an earlier stage and can follow them more precisely. Retailers are not directly involved in the project. But in working group 3, this need is identified by the argument for a clear product identification and codification system which is related to the product identification codes used by retailers.

It was reported that the initiation and participation of the FAA, FAH, TWF, Baardse, and Zurel was an important success factor. Those five parties knew each other very well and were also strongly dependent on one another. The auctions are attractive for the wholesalers because of their price-setting level, their size and the services they provide. The wholesalers are attractive for the auction houses because they are important buyers and sell their flowers worldwide.

Branch/EDI organization

During the contracting process of the EDI Flower project, the influence of the contracting environment in terms of the existence of branch or EDI organizations was clearly visible in two ways. Firstly in its relation to the initiation and involvement of the branch organization of the wholesalers in the EDI Flower project. Secondly in its relation to the influence of the VEDI program during the contracting process.

At the beginning of the EDI Flower project the branch organization TWF was actually one of the initiators. TWF kept up a sustained interest during the different phases of the project too, (due to the fact that one of the members of the steering group was an employee of TWF). This employee was also the leader of working group 2 and 3 during the first part of the design process.

The second influence was related to VEDI and the Ministry of Economic Affairs. During the contracting process (between April 1990 and November 1990) the participants asked an external consultancy organization to prepare a project plan to apply for subsidy from the VEDI program (Example EDI programme) run by the Ministry of Economic Affairs. This project plan was set up and sent to the program committee of the VEDI program after it was redefined. They decided not to chose the EDI Flower project as an Example project within the VEDI program. They based their decision on the argument that the project plan did not link up with the results that had already been realized and the activities already embarked upon. They concluded that it was a project plan without a basis. After the rejection the project manager made a new project plan. This project plan was accepted by the VEDI program committee and the Ministry, and on December 19, 1990 it was chosen as a VEDI project. Subsidy was given up to a maximum of 500.000 guilders. Four conditions were set by the ministry:

1. The EDIFACT standard had to be used to arrive at an open structure and to provide communication with other sectors;
2. The developed messages had to be placed under a maintaining EDI organization. That organization had to provide the results to other organizations in the sector;
3. The involvement of the education field was to be encouraged by attracting one student for an internship;
4. One representative of the (primary) agricultural sector was to become a member of the steering group.

After this decision it was decided in the steering group that the following changes had to be implemented:

- To apply the EDIFACT standard;
- To invite a representative from the NTS (Dutch Horticultural Study group);
- To set up the policy group EDI Flower Platform;

- To inform the VEDI commission;
- To keep track of the financial conditions;
- To attend the VEDI seminars.

Especially the first change was difficult to implement because the working-group's project plans had already been approved. For the working groups already installed it became unclear what the impact of those changes to their activities would be.

Level of cooperativeness of the contracting environment
The important indicator for the level of cooperativeness was the involvement of a branch/EDI organization. In the EDI Flower project one branch organization (TWF) strongly initiated the project. The level of cooperativeness of the contracting environment was measured in the same way as it was done in the survey. The level of cooperativeness of the horticultural sector was 3.0 on a scale between 1 to 5. The average level of cooperativeness for the 35 EDI projects, as investigated in the survey, was 2.26. The horticultural sector was more cooperative compared to the average.

Contracting management

Contracting management
The recommendations at the end of the broadening process, as described in section 7.4, were the starting point of the contracting process. The new project leader was appointed. He consulted all participating and interested organizations. On August 30, 1990 the project start-up meeting was held. In that meeting the philosophy, global plan, instructions for every working group and agreements on project management were made. The first objective of the project was defined as:

> '*To realize, in a practical way, a reasonable volume of electronic data interchange by simple and easily accessible solutions.*'

In line with this objective a strict message and technical standardization was not to be pursued. It was announced that in the first phase of the project the exchange would not be done by EDIFACT standards. Only some conditions were set up to implement EDIFACT standards more easily in the future, like the development of a reference model and the investigation of the desired technical infrastructure.

The project concentrated on the message exchange between growers, auctions, wholesalers/exporters and their relations. Five working groups were distinguished. The first working group dealt with the message exchange between grower and auction house. They were instructed to define a supply letter and daily transcript, to deliberate with participating organizations on the technical realization and to implement the data exchange. The second working group dealt with the message exchange between auction house and wholesaler. They were instructed to define the transaction message, to define the supply message, to define the buyers bill and to implement the data exchange. The third working group dealt with the message exchange between exporters and their buyers. They were given instructions to explore the possibilities and desire for a data exchange with buyers from abroad and to suggest a pilot project. The fourth working group dealt with technology and its implementation. Their instructions were to come up with short term and long term technical solutions (in terms of a technical infrastructure) for the different message exchanges. The fifth working group dealt with the development of a reference model. A reference model is a data model and data dictionary of the messages to be exchanged in the chain of horticultural growers, auctions, wholesalers and their relations. The instruction was to develop data models for the data exchange between grower - auction, auction - wholesaler/exporter and wholesaler/exporter - relations. For the first three working groups the messages to be designed are described in figure 7.2.

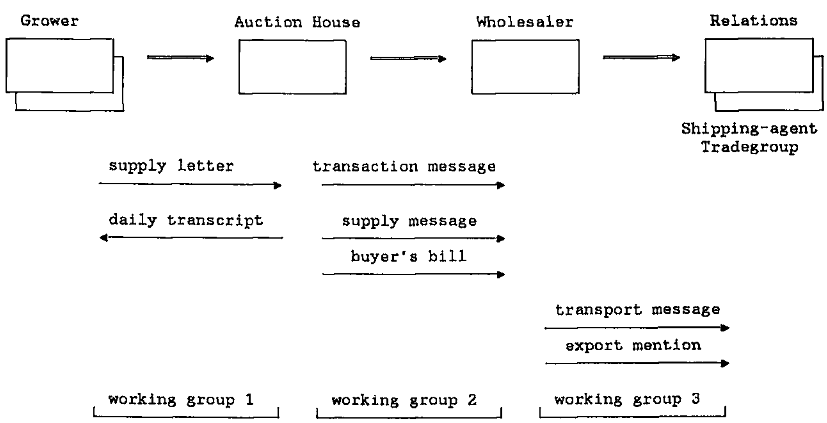

Figure 7.2: seven messages to be designed in the EDI Flower project within three working groups (EDI Flower 1990:3).

Level of contracting management
The level of contracting management was measured in the same way as it was done in the survey. The level of contracting management for the EDI Flower project was 3.28 on a scale from 1 to 5. The average level for the 35 EDI projects was 2.99. The EDI Flower project had a slightly higher level of contracting management compared with the average.

Contracting success

Contracting success
Each of the working groups had to prepare a project plan, which would be agreed by the steering group. In the steering group meeting of November 15, 1990, the different plans were presented by each working-group leader, see EDI Flower (1990). In every plan objectives, starting-points, activities, products, planning, and capacity were described. No special attention was paid to the quality of the EDI system to be developed. The costs for the design of the EDI system (messages and technical infrastructure) was estimated at somewhere between 300,000 and 350,000 guilders. The delivery date was planned for August 1991.

An overall project plan was set up derived from the working-group project plans. With this project plan a subsidy from the VEDI program (Ministry of Economic Affairs) was obtained on December 19, 1990. The following changes had to be implemented to obtain the VEDI subsidy:

- The EDIFACT standard had to be applied;
- A representative of the NTS (Dutch Horticultural Study group) had to be invited to join in;
- The policy group EDI Flower Platform had to be set up;
- The VEDI commission had to be informed;
- The financial conditions had to be kept track of;
- The VEDI seminars had to be attended.

When the first invoices were sent to the Ministry of Economic Affairs they noticed that no formal cooperation contract had been signed by the organizations. The project manager made a short cooperation contract which was signed by the organizations around April 1991. In that cooperation contract only the responsibilities of the contracting parties (in terms of the assurance to implement the EDI system) were specified.

Level of contracting success

The level of contracting success was measured in the same way as it was done in the survey. The contracting success was operationalized in terms of level of specification of the cooperation contract. In this case the cooperation contracts signed in April 1991 were investigated. In the EDI Flower project the cooperation contract was almost unspecified. The level of specification was 0.05 on a scale from 0 to 1, which was much lower then the average of the 35 projects (0.46).

Design environment

The level of stability of the design environment was indicated by the 'automatization level', 'differences in automatization level', 'organizational changes', 'size' and 'uncertainty of the status of the EDI messages'. This last indicator was not used in the survey research for reasons of internal consistency. These indicators were used to describe the level of stability of the design environment of the EDI Flower project.

Automatization level

The automatization level of the growers and wholesaler is, in terms of the Nolan stage theory, in the control stage. This stage is characterized by the fact that automatization is made accountable to contractors. The auctions take place at a later stage: the integration stage. The characteristics of this stage are cost accounting and project management related to automatization.

Differences in automatization level

The difference in automatization level between the organizations is moderate. There was some difference reported between the automatization level of the auctions and the wholesalers and TWF. Problems arose during the design process due to the data-modelling techniques used. The wholesalers were not familiar with these new data-modelling techniques. One example of this lack of familiarity is to be found in the discussion of the transaction message, where the lack of clarity of the message related to the functional requirements and the data model of the transaction message caused much more tuning between the working groups than had been planned.

Organizational changes

During the design process there were few organizational changes by the organizations. For example, in the first steering group meeting of the design process, organizational changes were discussed. These organizational changes were due to the fact that: (1) within FAA a new organizational structure had been implemented therefore the chairman of the steering group would take a different position; (2) the steering group representative of TWF (and also project leader of working group 2 and 3) was leaving TWF.

Organizational size

The organizations differ widely in terms of size. The auctions have more then 2000 employees, the wholesalers employ between 20 and 100 people and the number of growers is small, between 1 and 20 people. In particular, the small number of growers necessitated special adjustments in terms of the costs of EDI software. It was reported that growers could only effort cheap EDI software. The auctions negotiated with a software supplier who would provide cheap software packages for the growers.

Uncertainty legal/fiscal status

During the design process there was no uncertainty reported about the legal or fiscal status of the EDI messages to be designed.

Level of stability of the design environment

The level of stability was measured in the same way as it had been done in the survey. The level of stability of the design environment of the EDI Flower project was 2.5 on a scale from 1 to 5. The average level of stability for the 35 EDI projects, as investigated in the survey, was 2.88. The design environment of the EDI Flower project was less stable when compared with the average.

Design management

Design working groups

In the design process each of the five working groups started to work according to their project plan. Each of these five working groups will be discussed briefly.

Working group 1 had to deal with the message exchange between grower and auction. Two messages were developed: the supply letter and the daily transcript. For the supply-letter message functional requirements were set up, costs/benefit analysis were made and the functional requirements were translated into an EDIFACT version of the message. The progress of the working group was delayed because there was no simple and cheap EDIFACT conversion software package available for small organizations viz. the growers. The conversion package will be installed by the existing suppliers of software in the horticulture sector. One of the demands was that the software package should be flexible. After one year of negotiations the auctions came to an agreement with one supplier of conversion software. They were to develop the software and install these packages by growers. It was expected that by the end of 1992 the packages would be developed and installed for the growers. Also, in May 1992, the auctions decided, ahead of the EDIFACT version, to implement an electronic supply letter based on the already existing horticultural standard. Approximately 100 growers will communicate using this standard message and 100,000 electronic supply letters will be communicated annually. The second message deals with the daily transcript. After selling their products by the auction clock or the mediation bureau the growers receive a specification of the price obtained for the product and the average daily prices of all products supplied (cut flowers, pot plants). This information can be obtained by post or by videotex. Within the videotex application it is possible to obtain a daily transcript file for administration purposes. The working group investigated whether the videotex messages could be exchanged by EDIFACT messages. The EDIFACT messages have been determined and will be implemented around July 1993.

In *working group 2*, attention was paid to three messages from auctions to wholesalers: the transaction message, the supply message, and the buyer's bill. For the transaction message, the emphasis was on the functional requirements of the transaction message. Functional requirements were translated into an EDIFACT version of the message. In the summer of 1992 two auctions and two wholesalers bought the EDIFACT conversion software packages. A pilot study was set up for three months. In this period approximately 200 transaction messages a day were exchanged. With regard to the supply messages, it was difficult to define a standard message, because there are two groups of wholesalers. One group first buys their products on the basis of the selling prognosis and then they sell them. The second group first sells and then buys the products. Both groups need different supply information on the actual day and for the coming days. It was concluded that no standard information demand could be specified. For each wholesaler, product segment and market segment different information was needed. New information, like colour and perishability of the flowers, was asked for by the wholesalers but this information could not be provided by the auctions in the near future. In working group 2 not much attention was given to the third message (buyer's bill) due to the need to maintain certain priorities and the lack of human resources.

In *working group 3* the focus was on the message exchange between wholesalers and their relations (shipping agents, TWF, retailers). One of the messages investigated was the transport message. It was concluded that the shipping agents were not ready for automatized message exchange. Factors leading to this decision were related to the automatization level of the shipping agents, administrative procedures related to plant disease and customs regulations. The added value of an electronic transport message was indicated as being low. The second message of working group 3 dealt with the export mention. It was investigated whether the export mention could be translated into an EDIFACT standard message. They concluded that a translation was useful if shipping agents used other messages along with the EDIFACT standard. In general, working group 3 concluded that for a successful implementation of EDI a uniform product code would be essential. In the horticultural sector the innovation level is high. New products are frequently introduced. Until now only bilateral agreements have been set up on product codes between specific buyers and sellers. In working group 3 a coding system was developed and will be tested in the near future.

In *working group 4* the focus was on technology and implementation. First a recommendation was presented on the technical infrastructure operating between grower and auction. A Memocom-postbox system was recommended. For the relation auction and wholesaler the working group developed different alternatives. As most wholesalers share the same building as the auction it might be useful to make a connection with the (internal) auction networks. For the first step the working group also advised the Memocom-postbox system.

In *working group 5* a reference model was developed. The reference model deals with relevant entities and the relationships of the messages to be developed. The entities and relationships are described in a data model and data dictionary. Newly developed messages will be compared with the reference model.

Design management

In the survey data four evident factors were found related to level of design management. Those factors were 'level of process management', 'aspects of EDI systems', 'relation with top-management', 'relation designers/users'. These factors will be used to describe the level of design management of the EDI Flower project.

Level of process management

In the EDI Flower project the project manager was the person who dealt with the project management. The project was rather complex: one external project manager, five working groups, many organizations, several participants involved in different working groups and several messages to be designed. It was reported that sufficient resources had been credited to the project; with the help of standards and procedures the design process was tracked; and that the project was controlled by identifying changing design requirements. The design process was defined with documented standards with regard to resource requirements, planning and product plans. The execution of the design activities was done randomly. The design process was analyzed by using measurements of used human resources versus required resources. The design process was controlled by identifying procedures and responsibilities with regard to design requirements, design process standards, costs control and design validation. There was some time available to insert technology into the design process.

Aspects of EDI systems

During the design process much attention was given to the technical architecture, data modelling, message standardization, standard EDI software and organizational design. Data modelling and messages standardization in particular got a great deal of attention and problems in these areas were reported. Also the standard EDI software, especially for growers, was problematic. In the beginning of the design process the focus was on the data aspect of the EDI system: one had to choose the relevant data for a specific message. This made the semantics of the data elements important. In this respect, three important events could be distinguished in the design process. The *first* event was the tuning of the data between two auctions. For example, in working group 1 they focused on the differences between the two auctions with regard to the supply letter. The *second* event was the tuning of data between auctions and wholesalers. For example, in working group 2 they had to design the transaction message. There were fundamental differences in the use of some of the relevant data elements in that message. End users needed more time then expected to agree on the specific elements of the message. It became clear that they had focused too much on attributes of the messages and less on the structure and data model (entities) of the messages. The *third* event was the tuning between the locally-agreed message content and the transformation into a EDIFACT standard message. The problem was that no clear instruction was available about how to convert the local message into a (new) EDIFACT message. Until now it has been unclear as to what criteria must be used in that conversion process. The criteria used seem to be subjective and chosen randomly.

Relation with top management

As already pointed out, the top management of the organizations formulated starting points for the project management and the design of the EDI system. Top management gained insight into the design process because no commitments were made without their approval. In addition, every design activity in the design process was subject to detailed planning. During the design process a policy group was set up: the EDI Flower Platform. This activity was initiated by the initiators of the EDI Flower project and stimulated by the Ministry of Economic Affairs. Its purpose was to increase the basis for EDI in the horticultural sector. The first meeting was held in June 1991. Representatives of the Ministry of Agriculture, Environment and Fisheries, retailer (Albert Heijn), branch communication network Bloemtel, Agrarica Platform (software providers), Dutch Horticulture Study groups (NTS), Dutch United Auctions (VBN) and the organizations already participating attended this meeting.

Relation designers/users

Communication between designers and users was structured in the working groups 1, 2 and 3. Users participated in those working groups. During the design process, so-called EDI officers were appointed for the two auctions. Those EDI officers were the link between the designers in the EDI project and the users of the organization. The EDI officers were the working group leaders of the two working groups. There was moderate tuning between the decision-making in the project and the decision-making in the organizations. No technology environment was created in the project. There was a great deal of emphasis on user involvement in the design process.

Level of design management

The level of design management was measured in the same way as it was done in the survey. The level of design management for the EDI Flower project was 2.64 on a scale from 1 to 5. The average level for the 35 EDI projects was 2.80. The EDI Flower project has a lower level of design management if compared with the average. It is interesting to notice which indicators were measured on a lower or a higher level compared with the level taken as the average of all indicators. Indicators with a lower level than the average of the EDI Flower level of design management were:

- Training (H8). No training was submitted during the design process;
- Subcontracting (H12). The relation with subcontractors (software suppliers) was not specified;
- Execution (H15). The execution of design activities was done randomly. For example, no development method was used;
- Technology environment (H19). There was no technology environment created.

Indicators with a higher level were:

- Representation of actors (H6). The organizations were well represented in the project;
- Technical architecture (H20). Much attention was given to the technical architecture (in working group 4);
- Message standardization (H22). Much attention was given to standardized messages by using EDIFACT;
- Standard EDI software (H23). EDI standard software was very much used;
- User involvement (H24). There was much user involvement in the design process;
- Organizational design (H25). A great deal of attention was paid to the organizational design related to the EDI system design. For example, a plan was set up for the EDI Flower organization, which will be responsible for the implementation and maintenance of the EDI subsystems and their messages.

EDI system-design success

Three dimensions

EDI system-design success was measured along three dimensions: quality, costs and delivery time. Each of these three dimensions will be discussed.

The quality dimension had to deal with the realized versus planned quality attributes of the EDI system. Two problems arose here when measuring this dimension. The first problem was due to the fact that in the EDI Flower project system design, a distinction was made between the hardware domain (network and communication infrastructure, investigated by working group 4) and the data and software domain (messages and software, investigated by working groups 1, 2, and 3, for each of the relationships in the horticultural chain). It was therefore not possible to speak about one EDI system design, there were several basic designs. The second problem was that the quality dimension was barely specified at the beginning of the design process (neither in the cooperation contract nor in the working group plans). The working groups focused on mutual agreement between the organizations on the functionality of the newly designed messages. If mutual agreement was reached support was also gained for implementation. For the EDI Flower project, a decision was made to measure the quality of the technical infrastructure.

The costs dimension was much easier to measure. Instead of the planned costs (300,000 - 350,000) the realized design costs were between 400,000 and 450,000 guilders. Three factors could be identified as the causes of these higher costs. The first one was that users in the working groups needed more time (and therefore more funds) to agree to the functional content of the messages. The second factor was related to the inexperience of the members of the working groups with EDI. The third factor was related to the complexity of the daily transcript which generated more and detailed investigation.

The time dimension was also easy to measure. The planned delivery date was scheduled in August 1991. The realized delivery date for the different parts of the project was as follows. The results of working group 4 and 5 were delivered around September 1991. Also the design of the supply letter and the transaction message was finished during that month. The supply message was delivered in July 1992 and the daily transcript was delivered in September 1992.

The following factors caused this delivery one year later than planned. First, there were the factors which were also mentioned earlier in relation to the costs dimension. Second, there was the issue of the project planning. In the original project plan the proposal was to design seven parallel messages in three working groups, as listed in figure 7.2. During the design process it became clear that not all the messages were as urgently needed as were proposed. Also it became clear that designing messages was more complex than had been expected. Therefore a decision was taken to continue with four messages (supply letter, daily transcript, transaction message, supply message) and design these messages sequentially instead of having them run parallel.

The priority of the three dimensions was also investigated. The project manager gave the highest priority to the quality dimension (100 points). Costs and time dimension had almost no priority. This was due to the fact that internal costs for the participating organizations were not a problem, organizations had working versions for the different messages and the internal application systems were not yet ready for electronic communication. These results differed from the results of the survey. The average ranking of the 35 EDI projects for the quality dimension was 50 points, for the costs dimension 27 points and for the time dimension 23 points.

EDI system-design success

EDI system-design success was measured in the same way as it had been done in the survey. Although we have to take into account the problems met by measuring the quality dimension, EDI system-design success for the EDI Flower project was 0.67 on a scale from 0 to 1. The average EDI system-design success for the 35 EDI projects was 0.64. The EDI Flower project has almost the same level of design success as the average.

In the next sections answers to the four central questions will be presented by using the analysis scheme in figure 7.1.

7.6 Relation between contracting environment and contracting management

This section returns to the first of the four questions, which were investigated in more detail in section 7.2. For the relation between contracting environment and contracting management it was decided to concentrate on case hypothesis 2, 3 and 4. Each of these case hypotheses will be discussed.

CH2: In reality there is a relationship between the constructs *contracting environment* and *contracting management* but the variables are not refined in such a way that they are related to the construct;

The construct contracting environment was refined into the variable 'level of cooperativeness of the contracting environment'. The construct contracting management was refined into the variable 'level of contracting management'. Especially the construct contracting environment seems to trouble the relationship.

Two conclusions could be made after analysing the case study data. These two conclusions are:

- The contracting environment has a much more dynamic character than originally expected;
- The variable level of competition with other platforms/networks might influence the level of contracting management.

These conclusions will be discussed in more detail.

Dynamics of contracting environment

It was reported from the case study data that the contracting environment was much more dynamic than had been anticipated. The contracting environment of the EDI Flower project could be divided into four groups. The first group consists of the combination of historically involved and contracted organizations. Five organizations are in this group (FAA, FAH, TWF, Baardse, Zurel). The second group consists of the combination of already involved and not-contracted organizations. Organizations like GEIS and Twijnstra Gudde are in this group. The third group deals with newly-involved and contracted organizations. Organizations like Agritect Advies, SITU and Wageningen Agricultural University are in this group. But the Ministry of Economic Affairs is in this group too. The fourth group are organizations which were newly-involved but not contracted. For example BNG (a consultancy organization) is in this group. They were involved in getting the VEDI subsidy but did not succeed.

Competition with other platforms/networks

The case study results suggested that the variable level of competition with other EDI platforms might influence strategic behaviour during the contracting process. It could be hypothesized that a higher level of competition with other EDI platforms will increase the level of contracting management. During the contracting process, competition with another platform viz. the EDI Agro Platform was conspicious. EDI Agro Platform is a Dutch platform of information providers and information users in the Agricultural sector. In the contracting process there were discussions on several occasions about participants' membership of the EDI Agro Platform and their participation in a feasibility study on the setting up of an agricultural network organization. The following aspects played a role in the decision not to participate in the platform and the feasibility study:

- One EDI Agro platform and therefore one development process within the agricultural sector is too complex;
- The different chains or sectors have differentiated connections and fewer dependencies.

Therefore the EDI Flower participants decided not to participate in the EDI Agro Platform.

It was concluded that case hypothesis 2 could be rejected for the first question. The variable seems to relate to the construct. A new variable was distinguished.

CH3: In reality there is a relationship between the constructs *contracting environment* and *contracting management* and the variables are refined in such a way that they are related to the construct but the indicators are not related to the variables;

The variable level of cooperativeness was refined in the indicators 'level of competition', 'stage of growth cycle', 'stage of product/market cycle', 'bargaining power' and 'branch/EDI organization'. Also the case study data reported no strong relationship between the first four indicators and the variable level of cooperativeness of the sector.

Organizational interaction indicators

One of the difficulties of the chosen indicators 'level of competition', 'stage of growth cycle', 'stage of product/market cycle', and 'bargaining power' was the multiple organization character of those indicators. The indicator indicates an object related to the sector which is the result of a complex interaction between organizations. One indicator measured by one respondent could hardly be accurate for those complex interactions between organizations. In those cases it might be better to investigate the different organizations.

Case hypothesis 3 was rejected for question one. Some indicators seem to be unrelated, but the indicator 'branch/EDI organization' is. There were no new indicators reported in the case study. It was suggested, in the light of the dynamics of the contracting environment, to measure indicators in the different organizations of the contracting environment.

CH4: In reality there is a relationship between the constructs, variables and indicators, but the items belonging to the indicators were not measured in the proper way;

No difficulties were reported on items belonging to the indicators. So case hypothesis 4 was rejected for the first question.

7.7 Relation between contracting success and EDI system-design success

In this section the second question was investigated dealing with the relationship between contracting success and EDI system-design success. Hypothesis 3 and 4 were the main focus.

CH3: In reality there is a relationship between the constructs *contracting success* and *EDI system-design success* and the variables are refined in such a way that they are related to the construct but the indicators are not related to the variables;

The construct contracting success was refined into the variable 'level of specification of the contract'. No new indicators were reported in the case study for the level of specification of the contract. The construct EDI system-design success was refined into the variable as 'the way the planned quality, costs and time related to EDI system design were realized'. As far as the indicators for the quality, costs and time dimension of the EDI system design were concerned, no new indicators were reported in the case study. So case hypothesis 3 could be rejected for the second question. The indicators seem to relate to the variables.

CH4: In reality there is a relationship between the constructs, variables and indicators, but the items belonging to the indicators were not measured in the proper way;

It was reported that in the case study there were two problems in the measurement of the quality of EDI system design. Those two problems were:

- The quality of the EDI system design was measured by identifying the design of one EDI system. In the EDI Flower project there was one technical infrastructure with several EDI applications.
- The quality dimension was measured by indicating the completely realized and not completely realized quality attributes in the EDI system design. A little bias could be introduced by not measuring the, often not explicit, planned quality of the EDI system design.

Case hypothesis 4 could not be rejected for the second question. The indicator 'planned quality attributes' of the EDI system design was difficult to measure. It was suggested that the measurement of the planned quality dimension of the EDI system design should be improved.

7.8 Relation between design environment and design management

In this section the third question was investigated, dealing with the relationship between design environment and design management. It was decided that all four hypotheses would be concentrated on.

CH1: In reality there is no relationship between the constructs *design environment* and *design management*;

In the survey and the case study no evidence was found for a strong relationship between the constructs design environment and design management. No strong variables could be extracted from the design environment which could relate to the level of design management. It seems that when the design process is started the only influence comes from newly-involved organizations which are directly related to the EDI system design, like software suppliers and technical infrastructure suppliers. In the case-study data a strong influence was reported from the EDI software supplier. They had a strong influence on the progress of the design process and the outcome of the design process.

Case hypothesis 1 could be rejected. There seems to be a relationship between the constructs design environment and design management.

CH2: In reality there is a relationship between the constructs *design environment* and *design management* but the variables are not refined in such a way that they are related to the construct;

The construct design environment was refined into the variable 'level of stability of the design environment', which was indicated by 'automatization level', 'differences in automatization level', 'organizational changes', 'size', and 'legal/fiscal aspects'. The construct design management was refined into the variable 'level of design management'. Here too, the construct design environment seemed to trouble the relationship. It was concluded, after analysing the case study data, that the design environment has a much more dynamic character then expected and stableness seems to be difficult to measure in this relatively dynamic design environment.

Dynamics of design environment

The design environment of the EDI Flower project could be divided into four groups. The first group consists of organizations which are already involved and related to the EDI system design. Again in this group are FAA, FAH, TWF, Baardse, Zurel. The second group consists of organizations already involved and not related to the design. No organizations were part of this group. The third group consists of newly-involved organizations related to the EDI system design. Newly involved organizations related to the design were the hundred growers (who will use the EDI system), the network provider (PTT Nederland) and the software provider (Walvis). The fourth group consists of newly-involved organizations which are not directly related to the EDI system design. An example of this was the setting up of a policy group during the design process. Involved in those group organizations were bodies not directly connected to the design, like for example the Ministry of Agriculture, Environment and Fisheries, and the Dutch Horticultural Study Group.

Involvement of EDI software providers

The variable 'level of stability of the design environment' could not clearly be recognized in the case study data. In the case study data a strong influence was reported from the EDI software provider on the progress of the design process. This was especially the case in working group 1. It was suggested that the variable 'level of involvement of EDI software providers' be introduced.

Case hypothesis 2 could not be rejected. The variable 'level of stability of the design environment' seems not related to the construct design environment. It was suggested that the variable 'level of stability of the design environment' be removed. A new variable 'level of involvement of EDI software providers' was suggested.

CH3: In reality there is a relationship between the constructs (mentioned in that specific question) and the variables are refined in such a way that they are related to the construct but the indicators are not related to the variables;

Organizational interaction indicators

Apart from the arguments related to case hypothesis 1 and 2 there were also indicator problems reported in the case study. The level of stability of the design environment indicators 'automatization level', 'differences in automatization level', 'organizational changes', 'organizational size' had a multiple organization character. The indicators indicate an object which is the result of a complex interaction between organizations or indicate an object for each organization. One indicator measured by one respondent could hardly be accurate for those complex interactions between organizations or differences between organizations. In those cases it might be better to investigate the different organizations participating.

Case hypothesis 3 could not be rejected. The indicators seem not to relate to the variable. It was suggested that indicators in the different organizations of the design environment be measured.

CH4: In reality there is a relationship between the constructs, variables and indicators, but the items belonging to the indicators were not measured in the proper way;

No new insight was reported in relation to this hypothesis for the case study results. Case hypothesis 4 could be rejected.

7.9 Relation between design management and EDI system-design success

It was reported in the survey that the level of contracting management, contracting success and level of design management explained 32.9 % of the measured variance of EDI system-design success. It was also reported that the level of design management explained 13.3% of the measured variation of EDI system-design success. This study is interested in the last result and investigated hypothesis 3 and 4 for this relationship.

CH3: In reality there is a relationship between the constructs *design managment* and *EDI system-design success* and the variables are refined in such a way that they are related to the construct but the indicators are not related to the variables;

Ambition levels

To determine EDI system-design success it was reported that it might be worthwhile identifying other ways of measuring success. For example, variables related to the ambition level of the planned dimensions of the EDI system design, the reason being that the variable 'planned' versus 'realized' does not take into account low ambition levels (and easy to realize dimensions) as opposed to high ambition levels (and more difficult to realize dimensions). Low and high are normative and further research could be focused on these norms.

Changing requirements

It was reported in the case study that during the design process organizations changed their requirements towards the EDI system. This was due to the fact that the process was started with little knowledge about the strengths and weaknesses of EDI. During the design process knowledge was gained by designers and users and new insight resulted in changing requirements.

Learning

It was also reported that the organizations learned about the possibilities of EDI, but also learned about how to design and manage the design process. For example the EDI Flower project started ambitiously by designing seven messages in several links of the horticultural chain. But during the design process it was decided to continue with four messages (supply letter, daily transcript, transaction message, supply message) and design these messages sequentially instead of running them parallel.

Relationship

In analysing the design management and EDI system-design success it became clear that the relationship is much more dynamic than might have been expected.

Measuring design success by measuring the planned versus the realized dimensions of the EDI system design does not taken into account:

- That situation which arises when a low or a high level of ambition is aimed at in the planned dimensions of the EDI system design is not taken into account even though it may influence the relationship between level of design management and EDI system-design success;
- That newly-gained insight arrived at during the design process may change the level of design management during the design process;
- That newly-gained insight arrived at during the design process may change the requirements, for example by users, towards the EDI system design.

Although there were other ways of measuring EDI system-design success, it became clear that case hypothesis 3 could be rejected. The indicators are related to the variable EDI system-design success. The indicators for level of design management are consistent related to the variable level of design management.

CH4: In reality there is a relationship between the constructs, variables and indicators, but the items belonging to the indicators were not measured in the proper way;

In the case study two problems were reported related to the quality of the EDI system design (see section 7.7). Case hypothesis 4 could not be rejected for the second question. The indicator 'planned quality attributes' of the EDI system design was difficult to measure.

7.10 Summary

- Why does the level of cooperativeness of the contracting environment explain only a small amount of the measured variation of the level of contracting management?

- It was concluded that:
  - The contracting environment has a much more dynamic character than anticipated. It was suggested that the research model be expanded with a new variable 'level of competition with other EDI platforms', which might influence the level of contracting management;

- The indicators of level of cooperativeness of the sector indicate an object which is the result of a complex interaction between organizations. One indicator measured by one respondent of the EDI project could hardly be accurate for those complex interactions between organizations. It was suggested that the indicators in the different organizations of the contracting environment be measured.

. Why does contracting success not effect EDI system-design success either directly or indirectly?

- The conclusions were that:
  - No new indicators were distinguished in the case study for the level of specification of the contract. No new indicators were reported in the case study related to the indicators for the quality, costs and time dimension of the EDI system design. Only a few indicators of the level of specification of the contract were directly related to EDI system design. The results of the case study indicate that in this project the EDI system design was weakly specified in the cooperation contract. Those last two reasons seems to be the answer to the question.

. Why does the level of stability of the design environment not explain the measured variation of the level of design management?

- It was concluded that:
  - The variable 'level of stability of the design environment' could not be recognized in the case study data. The design environment has a much more dynamic character than anticipated and stableness seems to be difficult to measure in this relatively dynamic design environment. It was suggested that this variable be removed from the research model;
  - It was suggested that a new variable 'level of involvement of EDI software providers' be introduced. This variable seems to influence the level of design management, as was reported in the case study;
  - Here too, the indicators measured by one respondent could hardly be accurate for those complex interactions between organizations or

differences between organizations. It was suggested that indicators in the different organizations of the design environment be measured.

. Why does the level of design management explain only a small amount of the measured variation of EDI system-design success?

- It was concluded that:
    . The indicators of EDI system-design success were measured in a proper way, only the indicator 'planned quality attributes' of the EDI system design was difficult to measure.
    . New ways of measuring success dealing with different ambition levels, changing requirements and learning devices might shed light on the relationship between level of design management and EDI system-design success;

In chapter 8 the survey and case study results will be interpreted. The suggestions for changing the research model have been taken into account and a revised research model will be presented in chapter 8.

PART III INTERPRETATION AND PERSPECTIVE

'Thwarted intentions, frustrated wants, unsatisfied desires, failed projects: this is the stuff of everyday life ...'

- Jon Elster, *Ulysses and the Sirens* -

'At the heart of his charge was the definition of circumstantial evidence because, as he noted, if the case was to be proved at all it would have to be by such connected and correlated evidence.'

- Simon Schama, *Dead certainties (unwarranted speculations)* -

8 INTERPRETATION AND DISCUSSION

8.1 Introduction

In chapter 6 the results of the survey were presented. Some specific questions were raised about non-significant results which were investigated more in depth by a case study of the EDI Flower project. The results of the case study were presented in chapter 7. Both chapters dealt with the first two central questions. Those two questions were: what factors are responsible for the success or failure of the design of an EDI system and how are these factors related? The purpose of this chapter is to interpret both survey and case study results in terms of the Decision-making school and the Environmental school. Like a member of the jury we have to prove the Design Management Theory guilty or innocent beyond reasonable doubt. The third central question will be answered:

- Why are the relevant factors responsible for the success or failure of the design of an EDI system?

The interpretation of the results of the survey and case study must lead to a better understanding of the relationship between specific variables and their effect on EDI system-design success. In regression analysis, used in chapter 6, the focus was on that part of the variation which is bounded by the independent variables. This part is called the explained variation. If the explained variation is greater it is more likely that the score of the dependent variable can be predicted - if the scores of the independent variables are known. Usually the prediction question is translated into a causality question (Nooij 1990:53). The researcher interprets the independent variables as causes of the dependent variable.

In section 8.2 the interpretation of the survey and case study results will be presented. In section 8.3 a revised research model will be discussed.

8.2 Variables and hypotheses

The survey and case study results have been interpreted for each variable and hypothesis. In figure 8.1 the specific research model will be presented once again. Firstly, the variables of the research model will be interpreted. Secondly, the hypotheses of the research model will be interpreted.

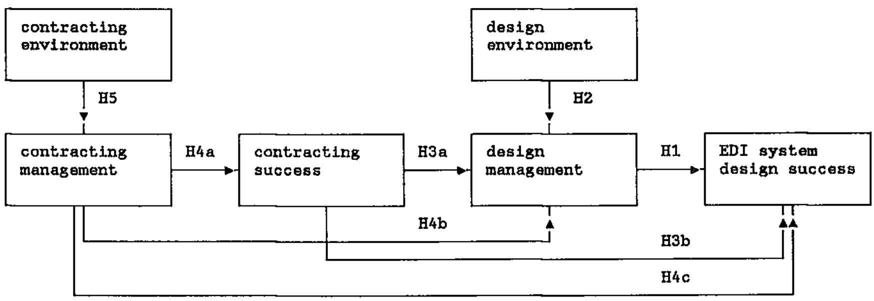

Figure 8.1: specific research model and hypotheses (for H3b, H4b and H4c only direct relationships are shown).

EDI system-design success

In 32 of the 35 cases in the survey research the design process resulted in an EDI system design. In 28 cases it was possible to measure the planned and realized quality, costs and delivery time of the EDI system design. None of the investigated projects were successful in terms of full realization of the planned quality, costs and delivery time of the EDI system design. The average EDI system-design success was 0.64 on a scale from 0 to 1. It seemed to be very difficult to realize the planned quality, costs and delivery time of the EDI system design. Reasons were given by project managers like:

> *'We had difficulties with the EDI software supplier. They promised more than they could deliver. Therefore we switched to another software supplier.'*

> *'One of our suppliers was struggling with internal difficulties, therefore the design process took much longer than expected.'*

'We were involved in the logistics for the Gulf War, so there was less personnel capacity and time for this project.'

EDI project managers were asked to rank a score for the importance of the three dimensions of EDI system-design success: quality, costs, delivery time. On average they divided the 100 points into 50 points for the quality dimension, 27 points for the costs dimension and 22 points for the time dimension. It can be concluded that EDI project managers find the quality of the EDI systems design twice as important as the costs or delivery time of the EDI system design. Those results correspond with results presented by Might and Fischer (1985). Their study draws on data collected by a mail survey of 103 development projects in 30 different firms. The relative weight given by their respondents was 54 points (54%) for technical performance, 23 points (23%) for cost performance and 22 points (22%) for schedule performance.

Three dimensions

The correlation coefficients between the three dimensions of EDI system-design success were investigated. The results were as follows (see section 5.4). There was a significant positive correlation between the quality dimension and the overall EDI system-design success. There was a significant positive correlation between the costs dimension and EDI system-design success. There was also a significant positive correlation between the time dimension and EDI system-design success. There was no significant correlation between the quality and the cost dimension, a significant negative correlation between the quality and time dimension and a significant positive correlation between the costs and time dimension. This can be interpreted as follows. It is obvious that successful EDI system designs are those designs which have higher realized quality, lower realized costs and are delivered sooner than expected. But EDI system-design success is highly correlated with the costs dimension. The quality and costs dimensions seem to be unrelated. That means that a lower realized quality does not automatically lead to lower realized costs and vice versa. The negative correlation between the quality and time dimension can be interpreted as: when the realized quality comes closer to that planned, the delivery date exceeds the specified delivery date by a longer period of time. The positive correlation between the costs and time dimensions can be interpreted as when the realized costs get closer to the planned costs, the realized delivery date gets closer to the planned delivery date. Closer realization of the quality does not go together with a closer realization of planned costs, but goes together with a later than planned realized delivery date. But when realized costs are closer to the planned costs, it goes with a closer to the planned realized delivery date. It would seem that a more realized quality of an EDI system design takes more time, but does not automatically lead to higher costs. It might be that designers need more time to think about their designs, although that does not exceed the specified design costs.

Relation with EDI system-implementation success
In section 6.6 the relation between EDI system-design success and EDI system-implementation success was explained. There was a statistically significant relationship between the objective measured EDI system-design success and the EDI system-implementation success of 0.665 ($F=15.8$, $p<0.001$). EDI system-design success explains 44.2% of the measured variation of the EDI system- implementation success. A successful EDI system design corresponds with a successfully implemented EDI system. The interpretation is that a better realized EDI system design, in terms of quality, costs, and delivery time, will result in a better implemented EDI system.

Design management

A higher level of design management deals with the way decision-making involving the initiation, direction and control of design activities was controlled and measured. The average level was 2.80 on a scale of 1 - 5. It seems that organizations are aware of the difficulties of developing EDI systems and take design management seriously. They reach higher levels compared with the results of internal IS development processes. For example, Keijzer (1992) quotes results from SEI who are using the Humphrey framework. In 1989, 85% of the investigated American organizations scored level 1, 13% scored level 2 and less then 1% scored level 3. In 1991 the research was repeated and the results were 81%, 17% and 7% respectively.

Four factors
According to the results of factor analysis on the 25 items of 'level of design management' four factors could be identified in a decreasing order of importance: *level of process management* (resources, tracking, project control, definition, execution, analysis, control, technology insertion), *level of attention to aspects of EDI system design* (technical architecture, data modelling design, message standardization, standard EDI software, organizational design), *relation with top management* (policy, oversight, planning), *relation between designers and users* (communication, connection decisions, technology environment, user involvement). Those four factors determine to a great

extent the level of design management. The first factor (level of process management) seems to play the most important role. Definition, analysis, execution, tracking and control are important elements. The second factor is the level of attention which is given to important aspects of the EDI systems design during the design-process. These aspects or domains of EDI systems cover the hardware, the software, the data, the user and the organization. The third factor deals with the relation with top-management. More involvement of top-management of the participating organizations towards the design process will lead to a higher level of design management. Two items (message standardization and standard EDI software) of factor two load strongly negatively to the third factor. The interpretation is that a higher level of attention to these aspects is related to a lower level of involvement of top management. Or, if top management is strongly involved in the design process it will lead to less attention to standard aspects of the EDI system design, because those standard aspects might decrease the flexibility of the EDI system. It can be hypothesized that top management do not favour the standard aspects of EDI. Resources seems to be important because they load positively on three factors: level of process management, aspects of EDI system design and relation with top management. The interpretation is that the resources needed are described by (project) management and used for the design viz. level of attention toward aspects of the design, and positively influenced by the relation with top management. The fourth factor deals with the relation between designer and user. Items like communication, connection with internal (organizational) decision-making, technology environment and user involvement play an important role. It shows that the more designers and users communicate and the more decisions are tuned between the organizations, and the more users are involved supported by a technology environment, the better the relation is between designer and user. A better relation between designer and user will lead to a better realization of the quality of the EDI system.

It became clear that the four factors are interconnected and that they have to be viewed in an *integral* manner. A higher level of design management means that all aspects of the four factors are to be directed and controlled on a higher level. It means that one has to focus not only on a higher level of process management, but also on a more mature approach to EDI system aspects, a better relationship with top-management and a better relationship with designers and users. With respect to the last factor, one can conclude that only focusing on a more dedicated design technology environment (design tools and methods) will only be successful if one also increases the level of the other factors.
Process support technology is only fruitful when it is embedded into a high (4 or 5) level of design management. At the lower levels this sophisticated process technology

(sometimes called CSCW (Computer Supported Cooperative Work) or IPSE (Integrated Process Support Environment), see Wastell (1991), or Groupware (systems that support a group of people in performing a particular task), see Hendriks (1991), are not used in the proper way because the technology environment is, in the factor analysis results of level of design management, strongly related with factor 1 'level of process management'.

Design environment

In the survey, the construct 'design environment' was refined into level of stability of the design environment e.g. the organizations in the EDI project. Indicators like 'automatization levels' of those organizations, 'differences in automatization level', 'organizational changes', and 'organizational size' were used. Those indicators were internally consistent with level of stability of the design environment. The average level of stability of the design environment of 35 EDI projects was 2.88 on a scale of 1 to 5. Case study results reported:

- That the variable level of stability of design environment could not be recognized in the case study data. It was suggested that this variable be removed from the research model;
- That there was a significant influence recognized from the level of involvement of EDI software providers;

Contracting success

In 12 of the 35 cases no cooperation contract existed before the design process started. Two interpretations can be given. The first one is that participating organizations trust each other implicitly. If this is the case they feel a cooperation contract is unsuitable. Indications for this interpretation can be found in one of the answers given by an EDI project manager when asked why there was no cooperation contract.

> *'Atmosphere between partners was such that agreements in the form of a contract were not necessary.'*

The second interpretation is that the participating organizations were uncertain about the advantages and disadvantages of EDI. They did not or could not commit themselves too strongly to the participating organizations. Some answers from EDI project managers support this interpretation:

> *'In this EDI project, there is relative unclearness about the future.'*

> *'We are not dominant in the market and we are therefore dependent on the market (our suppliers and buyers).'*

> *'It is too early for a specific EDI contract because it is a pilot project.'*

> *'It was not feasible in the contracting process.'*

Also one was asked why in some cases no attention was paid to the EDI system design in the cooperation contract. Some answers were:

> *'In this project there was agreement about the principles and there was no question of opting out.'*

> *'There was no need for a detailed design.'*

> *'There is a separate, close company set-up, the design and building of the EDI system is done on a basis of own risk involvement coupled with a reward structure based on a set percentage via the EDI-system-booked freight.'*

Where a specified cooperation contract was involved, the strategic objectives specified in the cooperation contract were centred around the speeding up of messages exchange, the standardization of messages, decreased transaction costs, decreased input faults and the coupling of internal information systems with the EDI system. In a more specified cooperation contract, attention is paid to elements like responsibilities of contractor and customer, costs of the EDI system design and costs of the implemented EDI system, liability of the contractor, quality and delivery time of the EDI system design. Almost no attention is given to fines to be imposed if there were faults in the product quality, costs and planning, and tax destination of margins. The interpretation could be that concluded contracts are positively oriented. There seems to be uncertainty about the expectations of the product for example the (expected) quality of the EDI system design is often not specified in the contract. Although project managers indicated the importance of the quality of the EDI system design, it was noticed that this dimension was not vey well specified in the cooperation contract. These results show some resemblance to Elias and Gerard's (1991). They identified three sorts of contracts: simple contracts, framework contracts, and communications agreements. The first type of contract governs the terms of a specific business transaction. The last two contracts govern the procedures to be followed in all future trading operations. In this study cooperation contracts i.e. a specific form of communications agreement were investigated. Our results correspond with the conclusion of Elias and Gerard (1991:65) that the existence of a communication agreement seems to be the exception rather than the rule at present.

Contract specification

In recent literature more attention has been given to contracts. For example Mehler (1991) showed the need for a precise Request for Proposal (RFP). He discussed the fact that a successful RFP must include exact descriptions and definitions of the system in precise language, and concrete deadlines as well as acceptance criteria for each stage of the project. Macneil (1980) defined a contract as the relations among parties to the process of projecting exchange into the future. He identified five elements of promise in exchange: the will of the promisor, the will of the promisee, present action to limit future choice, communication and measured reciprocity. But still the question arises why did so many organizations not specify a cooperation contract? An answer to this question can be found by using elements of the transaction cost theory and the agency theory. Transaction cost theory implies that properties of the transaction determine the efficient governance structure. When asset specificity and uncertainty is low, and transactions are relatively frequent, transactions will be governed by markets. High asset specificity and uncertainty will produce transactional difficulties which lead to transactions being internalized within the firm. Medium levels of asset specificity suggest bilateral relations. Agency theory is concerned with the basic organizational question of how to align principal and agent interests. The common theoretical construct of both approaches is the notion of contracts (Reve 1988:6). Transaction costs rise as a result of contractual hazards between opportunistic actors under the influence of uncertainty, bounded rationality, small numbers, information impactedness and asset specificity. Contractual hazards can be met by safeguards or trust, and the most cost effective governance structure will survive under competitive conditions. Williamson (1985) talks about '*contractual man*' in stead of Simon's '*administrative man*'. Implicit contracting and relational contracting, where trust plays a major role, are important elements (Macneil 1980). In agency theory, contracts become even more central. Organizations are defined as a nexus of contracts. The major organizational task becomes the design of incentive systems to avoid efficiency losses. Reve (1988) developed a contract theory of the firm grounded on transaction and agency theory. He distinguished internal contracts and external contracts. Complementary skills (which by definition are of medium-asset specificity) are efficiently governed by bilateral relations. The incentives which apply to bilateral relations are of a different kind from organizational incentives. Here the term interorganizational incentives are used to denote incentives which are applicable in external contracts (Reve 1988:10). So, external contracts are a function of complementary skills and interorganizational incentives. The following reasons could be distinguished for the existence of no contracts or minimally-specified contracts:

- There is no lack of trust between the partners;
- There are no complementary skills between the partners;
- There are no interorganizational incentives;
- The development and fulfilment of the contract was too costly.

It is difficult to measure these reasons objectively. With regard to the survey and case study data it seems that all four reasons could be identified.

Contracting management

A higher level of contracting management deals with the way decision-making dealing with the initiation, direction and control of contracting activities was controlled and measured. Indicators related to strategic planning, costs/benefits, demonstrable benefits, partner choice, human resources, mutual trust, and planning were used. The average level of contracting management was 2.99 on a scale from 1 to 5. The interpretation is that, in general, the decision-making dealing with the initiation, direction and control of contracting activities was moderately controlled and measured. Reasons for this phenomenon could be that in the contracting process top and middle managers of the participating organizations participate in the contracting-process. These managers work in a more mature way in terms of the items of contracting management. In some cases it was the first time managers of transaction-related organizations had worked closely together to find out what the best EDI solution might be for the participating organizations. As one of the EDI project managers said:

'This was the first time the automatization managers from the buyer's and their main supplier's firm had met each other on a regular basis.'

Two factors

According to the factor analysis of the level of contracting management data two factors could be identified. These two factors are *level of strategic behaviour* (strategic planning, costs/benefits, human resources, planning) and *level of dependency* between participating organizations (demonstrable benefits and partner choice). The interpretation is that these two factors determine, to a great extent, the level of contracting management. The first factor makes the *strategic choice perspective* within the Environmental school clearly visible. Organizations which are more aware of the strategic possibilities of EDI will initiate, direct and control the contracting activities on a higher level, see also Swagerman (1992). In the second factor the two items 'demonstrable benefits' and 'partner choice' load respectively positively and negatively on this factor. The interpretation is that a high specification of the demonstrable benefits for the participating organizations corresponds with a low level of partner choice. It seems that when a partner could not choose the benefits were highly specified. This could be the case if the project was initiated by a central organization (the hub organization) which then forced their many small suppliers (the spokes) to become involved in EDI. In this case there is no partner choice and the hub organization shows the specific demonstrable benefits openly. These two items seems to be poles of one dimension: the level of dependency between participating organizations. Higher demonstrable benefits and lower partner choice indicate a higher level of dependency and vice versa. The demonstrable benefits are the carrot for the small suppliers. The power of the large buyer is the stick for the small suppliers. A relationship is indicated here with the *resource-dependency view* within the contingency perspective. Pfeffer and Salancik (1978) argued that organizations have to be understood in terms of their dependence on other institutions in their environment that provide their resources, see section 3.4.

Strategic dilemma

Kubicek (1992) reported the strategic dilemma of EDI systems. Organizations have to choose whether to strive for competitive advantage by offering electronic data exchange with some customers or suppliers, that is by differentiating their system from that of competitors, or whether they will aim at larger rationalization effects by engaging in the development of an industry-wide EDI system together with their competitors. This was also experienced in the EDI Flower case. The two biggest auction houses were developing one EDI system together. One auction house could have competitive advantage by developing an EDI system on its own. Growers would agree to that because they are members of one auction house and they have an obligation to the auction. But wholesalers/exporters, who are buying from more then one auction house, would not agree to that system. During the contracting and design process of the EDI Flower project there was also a continuous discussion about the relationship with the EDI Agro Platform e.g. the development of a general agricultural network. Larger rationalization effects for the horticultural sector would probably not be obtained by a general agricultural network. That was why the EDI Flower organization did not collaborate in the development of the national agricultural network. This interpretation was also formulated by Kubicek (1992), who noticed an organization gap for reaching consensus between different branches in two investigated cases. He concluded that the existence of associations which represent all the subbranches involved seems to be a crucial factor. This factor was also distinguished in this study related to contracting environment.

Contracting environment

A higher level of cooperativeness of the contracting environment deals with the existence and involvement of EDI/Branch organizations. The average level of cooperativeness was 2.48 on a scale of 1 to 5. The interpretation is that the average level was due to the existence and involvement of EDI or branch organizations during the contracting process. The reasons are that EDI, although a relatively new phenomenon, seems to be well organized and introduced in the Netherlands. Ediforum has been installed as the central coordinating organization (Ediforum 1990). They have organized the National EDI congress since 1990. In 1991 there were 4500 Dutch organizations using EDI reported by Ediforum (1991), in 1992 10.000 user organizations were reported by Ediforum (1992). Ediforum (1992) cited 134 EDI projects in 1992. Subsequently the Ministry of Economic Affairs launched a VEDI program. Subsidy was given to 26 initiatives to develop EDI systems in several sectors of the Dutch economy. Meetings took place between participants of the EDI projects.

Hypothesis 1

H1: As the level of design management increases, the level of EDI system-design success increases.

Interpretation and Discussion

The survey results with regard to hypothesis H1 show that there is a significant relation to be found between level of design management and EDI system-design success. Level of design management explains 13.3% of the measured variation of EDI system-design success. The line which best fits the survey data is:

$$\textit{EDI system-design success} = 0.341 + 0.104 * \textit{level of design management}$$

Interpretation

The interpretation is that there is some evidence that a higher level of design management will result in a more successful EDI system design. EDI projects which manage the design activities at a higher level, and pay more attention to aspects of the EDI system, involve top-management more, and where designers and users are better related to each other, those projects realize more closely their planned quality, costs and delivery time of the EDI system design. But at the same time the level of explanation of the measured variance of EDI system-design success by design management is rather low. The question arises: which other factors explain the rest (86.7%) of the variation of EDI system-design success? One has to take into account:

- In general, high explanation levels in social scientific studies do not usually occur (Nooij, 1990). Actors (organizations, individuals) are difficult to predict using relatively simple conceptual models;
- That the conceptual model presented is this study deals with causal relationships between independent and dependent variables. The reality might be more complex, see Child (1977);
- It might be that the design activities themselves, which are not taken into account in this study, have a influence on the EDI system-design success;
- That case study results reported that different ambition levels, changing requirements and learning devices may influence the measurement of the relationship between level of design management and EDI system-design success;

The results indicate that EDI projects with a *higher level of design management* (1) have more time for real design activities, in which creativity, flexibility, and innovation play an important role, (2) evaluate in a more systematic way and therefore learn more in terms of the scope and desirabilities of EDI and the EDI system, its design activities, and the way those activities should be managed. EDI projects with a low level of design management demonstrate the limited rationality which brings managers, designers and users to the decision-making process which leads to '*muddle with a purpose*'.

Relation with subjective EDI system-design success

In the survey it was possible to measure subjective EDI system-design success and the level of design management for 35 cases. It was reported that there was a significant relationship to be measured between the subjective EDI system-design success and level of design management ($F=3.37, p=0.075$). The level of design management could explain 9.2% of the measured variance of the subjective EDI system-design success. The interpretation is that a higher level of design management effects the EDI system-design success whether measured subjectively or objectively. The subjectively measured EDI system-design success is perceived by the project managers. It indicates that the relationship is often recognized by project managers. The lower level of explained variance seems to be a result of the fact that project managers use fewer and more inaccurate indicators for EDI system-design success.

Hypothesis 2

H2: As the level of stability of the design environment increases, the level of design management increases.

The survey results with regard to hypothesis H2 showed that there is no significant relation to be found between level of stability of design environment and level of design management. Case study results show:

- That the design environment has a much more dynamic character then expected and stableness seems to be difficult to measure in this relatively dynamic design environment;
- The indicators measured by one respondent could hardly be accurate for those complex interactions between organizations or differences between organizations.

Interpretation

The interpretation is that a more stable design environment is not functionally related to a higher level of design management. These results are not similar to those of the contingency perspective which reported, for example, bureaucracies are only appropriate to stable environmental conditions and changing situations require organismic structures (Burns 1963); and Lawrence and Lorsch (1967), who reported a relationship between the organization's structure and its environment; and Miles and Snow (1984), who demonstrated that successful organizations achieve a strategic fit between their environment and their management strategies and structures. In section 3.4 the Environmental school was discussed. The interpretation of the results with regard to the relationship between design environment and design management is that the constructs are not under discussion but the relation between the constructs. It seems to be that the relationship is not a functional relationship in terms of the contingency perspective. It could be that the relationship is an interaction relationship, as discussed in the strategic choice and consistency perspective. A functional relationship deals with the linear relationship between an independent and dependent variable. In the interaction relationship independent and dependent variables interact and are sometimes nonlinear. The problem which arises is that if one might conclude that design environment and design management relationships are interactions, then one has to focus on measurement issues like verifying and validating measurement instruments. In the strategic choice and consistency perspectives these issues seem to have been neglected. The conclusion with regard to hypothesis 2 is clear: the level of stability of design environment does not have a relationship with the level of design management.

Hypothesis 3a and 3b

H3a: As the level of contracting success increases, the level of design management increases.

H3b: As the level of contracting success increases, the level of design management and the level of EDI system-design success increases.

Hypothesis 3a

The results with regard to hypothesis H3a show there is a significant relation to be found between contracting success and design management. Contracting success explains 24.5% of the measured variation of level of design management.

Hypothesis 3b

The results with regard to hypothesis H3b show that contracting success and design management have no significant effect on EDI system-design success.

Interpretation

The interpretation is that a higher specification causes a higher level of design management but this will not automatically cause a higher EDI system-design success.

It seems that the cooperation contract is used by the project managers to provide the circumstances for the realization of a higher level of design management and these possibilities are utilized by the project managers. For example, in the cooperation contracts, the responsibilities of contractor and customer were often be specified. The project manager could use these specifications to argue, for example, to increase human resources during the design process. In the survey and case study data it was reported that the quality of the EDI system was often not specified, or not accurately specified in the cooperation contract. Also the planned quality, costs and delivery time of the EDI system design were only three aspects of the measurement of the level of specification of the cooperation contract. It seems that those two reasons explain why a more specified contract will not automatically lead to a higher EDI system-design success. The case study data concluded that no new indicators were distinguished in the case study for the level of specification of the contract. No new indicators were reported in the case study related to the quality, costs and time dimension of the EDI system design .

Hypothesis 4a, 4b, and 4c

H4a: As the level of contracting management increases, the level of contracting success increases.

H4b: As the level of contracting management increases, the level of contracting success and the level of design management increases.

H4c: As the level of contracting management increases, the level of contracting success and the level of design management and the level of EDI system-design success increases.

Hypothesis 4a

The results with regard to hypothesis H4a show there is a significant relationship to be found between the level of contracting management and contracting success. The level of contracting management explains 30.2% of the measured variation of contracting success. The line which fits the data best is:

*Contracting success = -0.022 + 0.155 * level of contracting management.*

Hypothesis 4b

The result with regard to hypothesis H4b show that the level of contracting management-was found to have a significant effect on the level of design management. The level of contracting management explains 24.3 % of the measured variation of the level of design management.

Hypothesis 4c

The result of hypothesis H4c shows that level of contracting management has a significant effect on EDI system-design success. Level of contracting management explains 32.9% of the measured variance of EDI system-design success. Surprisingly, the effect of the level of contracting management on EDI system-design success is rather high.

Interpretation

The interpretation is as follows. If during the contracting-process more attention is given to strategic planning (and therefore strategic objectives), costs/benefits of EDI, demonstrable benefits of EDI for participating organizations, partner choice, human resources, an atmosphere of trust, and planning, then this will lead to a clear sense of on how to deal with the development of the EDI system and what the planned dimensions are for EDI system design for each organization. The results support the hypothesis that a more specified cooperation contract is explained by a *higher level of contracting management*. Two factors could be distinguished which represent the level of contracting management. These factors are level of strategic behaviour and level of dependency. It seems that organizations with a higher level of contracting management (1) behave more strategically, they are more aware of the possibilities, costs and benefits of EDI and the implications of it. The EDI strategy is derived from the strategic plans of the organizations, (2) are more resource-dependent on their suppliers or buyers. EDI projects with a low level of contracting management show uncertainty about their strategic choice or do not make a strategic choice at all. This might be caused by a weak involvement of general managers in the contracting process. If there is a clear understanding between the participating organizations it is easier to realize an EDI system design as planned in terms of quality, costs and delivery time. It seems that the level of contracting management is a very dominant factor in explaining the success or failure of the EDI system design. It indicates that organizations involved in the development of EDI systems have to focus on the level of contracting management if they want to succeed in the rest of the development life cycle of an EDI system. A higher level of contracting management will result in a more specified cooperation contract which can be used in the design process. Those results correspond with recent results of O'Callaghan et al. (1992). They argue that to achieve benefits from EDI, initial investment costs must be born by both the developer firm (source) and the adopter firm (target). The source firm bears the research and development costs to open its internal systems to linkages with its trading partners. The target firm incurs the cost of incorporating the EDI technology into its own internal systems. The system design decisions faced by the developing firm therefore affect (1) source firm R&D costs, (2) source firm operational savings and benefits, (3) source firm competitive advantage, (4) target firm implementation costs, and (5) target firm operational savings and benefits. Their results show that the relation benefits of EDI help justify the source firm's investment in creating the system. Another finding pertains to the relative importance placed on benefits of EDI linkage in the adoption decision. They argue that EDI developers should be willing to invest in *more expensive and complex systems* that promise more in terms of ongoing operational savings and service enhancement to the target firm, even if such systems involve greater implementation costs. Such systems would not only improve the chances for adoption, but also increase the likelihood of the relational benefits. In their study it became unclear just how expensive and complex those EDI systems would have to be. They say it is important to design a system that is technically idiosyncratic and requires significant investment in system-specific human capital (i.e., learning and internal organization adaptation). Their results illustrate that in designing more complex systems more emphasis is needed on the higher levels of contracting management and design management.

Hypothesis 5

H5: As the level of cooperativeness of the contracting environment increases, the level of contracting management increases.

The results with regard to hypothesis H5 show there is a significant relation to be found between contracting environment and contracting management. The level of cooperativeness of the contracting environment explains 9.4% of the measured variance of contracting management.

Interpretation

The interpretation is that in sectors were there are more EDI- and branch organizations the level of cooperativeness is higher. A higher level of cooperativeness causes a higher level of contracting management. It seems that EDI/branch organizations stimulate organizations to get started and they also provide the knowledge: about the possibilities of EDI, sometimes in terms of standardized EDI messages; about how to enable them to manage the contracting process on a higher level; provide support from their representatives.

This result was also recently reported by Kubicek (1992), who focused on the organizational gap in large scale EDI systems. He showed, in two case studies of large interbranch EDI systems, that the standardization of data key is a crucial, conflicting and long-lasting process. He argued that this process takes place outside the technical standardization committees and its success is largely dependent on the level of association within the branch.

It was reported from the case study results that:

- The contracting environment has a much more dynamic character then expected. That the definition of level of cooperativeness of contracting environment is too broad and therefore unclear. It was suggested that the definition be changed and it was suggested that the research model be expanded with a new variable 'level of competition with other EDI platforms' which might influence the level of contracting management;
- The indicators of level of cooperativeness of contracting environment indicate an object which is the result of a complex interaction between organizations. One indicator measured by one respondent could hardly be accurate for complex interactions between organizations.

The interpretation will result in a revised research model. The revised research model will be presented in the next section.

8.3 A revised research model

As a result of the survey and case study results and the interpretation of these results a revised research model will finally be presented. The revised research model has been changed with respect to three constructs: EDI system-design success, design environment, contracting environment.

As noticed in this study EDI is a technology in its infancy and has only just started to filter through, see also Ribbers (1992). Using Bemelmans (1987) terms, after initiation and diffusion, consolidation and integration will occur. He argued that in the initation and diffusion phase management deals with initiation and stimulation and phase 3 and 4 management changes towards coordination and regulation. In this study it was noticed that most organizations were learning how to deal with EDI and EDI system design and low levels of contracting and design management occured. In this study it seems that the contracting and design process of EDI systems can be characterized as a *logical incremental* process. Survey results and case study results show that:

- During the contracting process strategic behaviour and level of dependency influence to a certain extent the outcome of the design process e.g. the EDI system design.
- At the beginning of the design process most managers and designers do not know precisely where the solution will occur. Most projects started with a fairly unspecified contract in which the quality of the EDI system to be designed was not clearly specified. It seems to be done to keep goals broad and to avoid creating undue opposition.
- During the design process new information and knowledge becomes available about the strengths and weaknesses of the EDI concept in the specific context.

The most effective EDI system designs tend to emerge step by step from an iterative process in which managers, designers and users probe the future, experiment with EDI, and learn from incremental processes rather than through an overall concept specified in advance. The process is both logical and incremental, see Quinn (1980:58) and Quinn (1985). Properly managed, it is a conscious, purposeful, and proactive practice. Formal management and design methods and techniques can help to a certain extent to manage those incremental processes. At the present managing the design process of EDI systems can be characterized as *controlled chaos*.

Returning to the research model of the Design Management Theory, three problems were identified. The first problem deals with the measurement of EDI system-design success. The second problem deals with the relationship between contracting environment and contracting management. The third problem deals with the relation between design environment and design management. To solve these problems it was suggested, according to the interpretation of the survey and case study data, that the research model be revised in the following way. The contructs, variables and indicators related to design management and contracting management are valid and reliable and will not be changed.

EDI system-design success

Objective measurement

The measurement instrument as developed in this study was proven to be internally consistent and therefore reliable and useful. One issue in the case study made it clear that measuring the planned quality attributes of the EDI system design in those situations in which the attributes are not specified in the cooperation contract will result in a bias. In the future, EDI technology will move toward the consolidation and integration phase and the quality of EDI systems will be specified in more detail than it was at the time the study was undertaken.

Subjective measurement

In the case study it was reported that designing is sometimes learning. New requirements are distinguished and success could be related to the ability to learn. In that case an indicator could be developed in which planned quality attributes and realized quality attributes are related in a different way. The realized dimension could be measured by asking which newly-discovered quality attributes were described in the EDI system design.

A second issue was reported dealing with the ambition level of the planned EDI system design. In those cases in which a low ambition level was specified in terms of a small number of quality attributes it was easy to reach those objectives. For a more objective point of view it was possible to define and realize more quality attributes e.g. a higher ambition level. Further research could be carried out dealing with the definition of ambition levels related to the specific situation and the level of design management undertaken.

Design environment

The construct design environment was refined to incorporate the variable level of stability of the design environment. Although the variable was internally consistent, no significant relationship with level of design management could be proved. In the case study the influence of one new variable was reported. This variable deals with the involvement of the EDI software provider. In the EDI Flower project it was clear that a weak involvement of the EDI software provider at the beginning of the design process caused a delay in the design of the software domain of the EDI system.

Level of involvement of EDI software providers
The definition of the level of involvement of EDI software providers is the way software providers of EDI software are anticipating the design process. Indicators for the level of involvement could be 'duration of relation', 'dependency of EDI software provider', 'responsibilities of EDI software provider', 'liability of EDI software provider'. One of the weaknesses in the measurement of the indicators in the survey was that only the project manager was interviewed. In these complex environment-management interactions it seems wise to measure these indicators provided by the software-providing organizations too.

Contracting environment

The construct contracting environment was further refined into the variable level of cooperativeness of the contracting environment. It was reported that this variable was not internally consistent. In the survey and case study data it was concluded that the indicator 'level of involvement of EDI/branch organization' was highly recognized. The conclusion might be to define the variable 'level of involvement of EDI/branch organizations' with a new set of indicators. A second conclusion from the case study was that there seems to be a visible influence from the 'level of competition with other EDI platforms'. Those two new variables will be discussed.

Level of involvement of EDI/branch organizations
New indicators related to level of involvement of EDI/branch organizations could be 'ability to provide standard EDI messages', 'level of representation', 'level of knowledge provision related to EDI', 'level of experience with EDI'. In further research those indicators could be specified and tested in detail.

Level of competition with other EDI platforms
New indicators related to the level of competition with other EDI platforms could be 'difference in size of the EDI platforms', 'overlap in user groups', 'overlap in EDI messages provided by the EDI Platforms'. Those indicators could also be specified and tested in detail in further research.

8.4 Summary

The following questions were answered in this chapter:

. Why are the relevant factors responsible for the success or failure of the design of an EDI system?

- The results of this study are clear. There is some evidence that more successful EDI system designs are caused by higher levels of design management, which are caused by a more specified cooperation contract, which in turn is caused by a higher level of contracting management. The level of cooperation of the contracting environment e.g. the existence and involvement of EDI or branch organizations, and the level of competition with other EDI platforms has a functional relationship with the level of contracting management. The level of involvement of EDI software providers could have a functional relationship with the level of design management.

  Four factors are relevant in relation to the level of design management: *level of process management* (resources, tracking, project control, definition, execution, analysis, control, technology insertion), *level of attention to aspects of EDI system design* (technical architecture, data modelling design, message standardization, standard EDI software, organizational design), *relation with top management* (policy, oversight, planning), *relation between designer and user* (communication, connection decisions, technology environment, user-involvement). It seems that EDI projects with a higher level of process management, with more interest in the aspects of the EDI system, with more involvement of top-management in the EDI project and with a better relation between designers and users are more successful in terms of realizing the planned quality, costs and delivery time of their EDI system design.

  It seems that EDI projects with a *higher level of design management* (1) have more time for real design activities, in which creativity, flexibility, and innovation play an important role, (2) evaluate in a more systematic way and therefore learn more in terms of the scope and desirabilities of EDI and the EDI system, its design activities, and the way those activities should be managed. EDI projects with a low level of design management demonstrate the limited rationality which brings managers, designers and users to the decision-making process which leads to '*muddle with a purpose*'. The results support that a higher level of design management is explained by a more specified cooperation contract between the organizations.

Two factors are relevant in relation to the level of contracting management: *level of strategic behaviour* (strategic planning, costs/benefits, human resources, planning) and *level of dependency* between participating organizations (demonstrable benefits and partner choice). Actors who are more aware of the strategic impact of EDI systems and who are more dependent on each other manage the contracting on a higher level and are better able to specify a cooperation contract.

The results also support the hypothesis that a more specified cooperation contract is explained by a *higher level of contracting management*. Two factors could be distinguished which represent the level of contracting management. These factors are level of strategic behaviour and level of dependency. It seems that organizations with a higher level of contracting management (1) behave more strategically, they are more aware of the scope, costs and benefits of EDI and the implications of it, and the EDI strategy is derived from the strategic plans of the organizations, (2) are more resource-dependent on their suppliers or buyers. EDI projects with a low level of contracting management show uncertainty about their strategic choice or do not make a strategic choice at all. This might be caused by a weak involvement of general managers in the contracting process.

These results become very relevant because the results show a very strong support for the direct effect of the level of contracting management on EDI system-design success. There was some support for the hypothesis that the level of contracting management is positively affected by the level of cooperativeness of the contracting environment. EDI projects in which EDI or branch organizations were involved during the contracting process showed a higher level of contracting management. It seems that those *EDI/branch organizations* (1) provide knowledge about the possibilities of EDI in the sector, sometimes in terms of standardized EDI messages, (2) provide knowledge about how to manage those interorganizational processes, (3) in the case of branch organizations provide support from their representatives to develop an EDI system.

Interpretation and discussion resulted in a revised research model. In future research this revised research model can be tested.

9 SUMMARY AND CONCLUSIONS

9.1 Introduction

After a journey along the theoretical and empirical heights, the time has come to summarize and present the conclusions. The objectives of this present study are:

- To investigate the design process of EDI systems from a practical and theoretical perspective;
- To develop a model to describe factors relevant to EDI system-design success;
- To investigate the proposed model empirically.

In section 9.2 the research undertaken will be summarized and the general conclusions will be presented. In section 9.3 suggestions for further research related to the specialized field of Information Management will be presented.

9.2 Summary and conclusions

This study was started by making the statement that design is one of the most fascinating activities known to man, and that it might be possible to manage design activities in an effective way. Having come to the end of this study, EDI system design and the activities of its designers have lost none of their fascination. During the interviews with the EDI project managers one was intrigued by their enthusiasm, while the design activities showed a mixture of creativity and rationality. In this section the research undertaken and the final conclusions will be summarized.

Investigation into practice and theory

This study started by exploring the central questions from a practical and a theoretical point of view. In chapter 2 the characteristics of EDI systems and their development process were distinguished. An EDI system can be defined as a business facility to exchange structured and normative data between computers of transaction-related organizations. Five relevant domains of an EDI system can be distinguished: the technical domain, software domain, data domain, user domain and organizational domain. In an EDI system these domains interact and are subject to constant change. Automatization, in general, replaces the user and organizational domain by the technical and software domain. Special attention was paid to the definition of the quality of EDI systems. Two approaches were linked, the production management approach and the perceived quality approach. Dynamic and static quality attributes of EDI systems were distinguished which are relevant in the design process for respectively users and developers, and administrators of EDI systems. The factors characterizing the development of EDI systems were derived from different development methods used in practice. The important characteristics of these development methods are that they are project-oriented, follow the information system development life-cycle, distinguish processes and products, pay attention to strategic aspects of EDI, and start with the definition of pilot projects.

In chapter 3 the central questions were investigated from a theoretical point of view. Within organization theory there are two schools of thought, the Decision-making school and the Environmental school, which might shed light on the design management of EDI systems. Within the Decision-making school three perspectives can be identified: the rational perspective, the political perspective, and the garbage-can perspective. In the rational perspective the focus is on the characteristics of the rational actors - the means they use to cope with uncertainty and cognitive complexity - as well as on the characteristics of the objective environment in which they make their decisions. In such a world, one must give an account not only of substantive rationality - the extent to which appropriate courses of action were chosen - but also of procedural rationality - the effectiveness, in the light of human cognitive powers and limitations, of the procedures for choosing to take certain actions. Within the rational perspective, views from a disjointed and logically incrementalistic view were distinguished. The political perspective argues that the process of decision-making is disorderly and is strongly influenced by the distribution of power within and outside the organization. The garbage-can perspective uses the metaphor of garbage-can for decision-making. The garbage-can process is one in which problems, solutions, and participants move from one choice opportunity to another in such a way that the nature of the choice, the time it takes, and the problem it solves all depend on a relatively complicated intermeshing of elements. Within the Environmental school three perspectives were identified: the contingency perspective, the strategic choice perspective, and the consistency perspective. The contingency perspective argues that there is a functional, not a causal, relationship between designated environmental conditions and the appropriate management concepts and techniques for effective goal attainment. There has to be a close fit between the environment of the organization and their management strategies and structures. The strategic choice perspective argues that the direct source of variation in formal and structural arrangements is not the context of the organization, but the strategic decision-making process of the dominant coalition. The strategic decisions are influenced by the evaluation of the environment by the dominant coalition. The consistency approach formulates its central proposition as there has to be consistency between powers of the environment and actions and reactions of the organizations, between the internal structure and functioning of the organizations, and between the five aspect systems within organizations and their external counterparts. The five aspect systems are the entrepreneur system, the technological system, the managerial system, the social-psychological system, and the political system.

Decision-making is the key distinctive activity of managers and designers. Both schools of thought provided us with the following lessons. Lessons from the Decision-making school were that design can be defined as the discovery and elaboration of alternatives. Actors (managers, designers and users) may behave in a bounded or, more specifically, in a procedurally rational way in a design process. The effectiveness of the design process can be investigated by the procedures used to choose actions. The process of decision-making is sometimes disorderly and is strongly influenced by the distribution of power within and outside the organization. Lessons from the Environmental school were that design activities can be managed. Design management can be defined as the initiation, direction and control of design activities. There seems to be a functional relationship between designated environmental conditions and the appropriate management concepts and techniques for effective goal attainment. The strategic decision-making process of the dominant coalition plays a relevant role in the system development process.

Design Management Theory

A research model of the design process of EDI systems was developed that integrates the lessons from the perspectives of the Decision-making school and the Environmental school. The model represents the Design Management Theory. The model is based on the definition of EDI system-design success in such a way that the realized EDI system design meets the planned requirements in terms of quality, costs and delivery time. In the research model three important distinctions are made. The *first* distinction is made between the contracting and design process. The contracting process is defined as the course of contracting management and contracting activities resulting in a cooperation contract related to the development of an EDI system between transactions-related organizations. The input of the contracting process is the initiative taken by one or more organizations. The output of the contracting process is the cooperation contract. The design process is defined as the course of design management and design activities resulting in an EDI system design. The input of the design process is the cooperation contract. The output of the design process is the EDI system design. The *second* important distinction is made between management and activities. Management deals with the decision-making part of the process. Activities deal with the execution part of the process. The model focused on the management part e.g. contracting management and design management. Contracting management is defined as decision-making dealing with the initiation, direction and control of contracting activities. Design management is defined as decision-making dealing with the initiation, direction and control of design activities. The *third* distinction is made between management and environment. So, a distinction was made between contracting environment and design environment. Contracting environment is defined as the external variables which have a functional relationship with the contracting management within an EDI project. Design environment is defined as the external variables which have a functional relationship with the design management within an EDI project.

In the research model eight hypotheses are distinguished. It is hypothesized that EDI system-design success is positively affected by the level of design management. Level of design management is defined as the way decision-making dealing with the initiation, direction and control of design activities is controlled and measured. The level of stability of the design environment viz. the organizations participating is an important variable. It was hypothesized that the level of design management was positively affected by the stableness of the design environment. It was hypothesized that the level of design management is positively affected by the level of specification of the cooperation contract between the participating organizations in the EDI project. It was hypothesized that the level of specification of the cooperation contract is positively affected by the level of contracting management. The level of contracting management is defined as the way decision-making dealing with the initiation, direction and control of contracting activities is controlled and measured. It is argued that the level of cooperativeness of the contracting environment viz. the sector is an important variable. It was hypothesized that the level of contracting management is positively affected by the level of cooperativeness of the contracting environment. Direct and indirect effects of research model variables on EDI system-design success were identified.

An empirical investigation
The proposed model was investigated empirically by a survey research of 35 EDI projects and a case study of the EDI Flower project. A questionnaire was developed with a structured interview for the project manager of the EDI projects. The questionnaire was tested for validity and reliability. Reliability was assessed by means of Cronbach's alpha and by correlation coefficients. For the variable level of cooperativeness of the contracting environment further research was recommended to find better indicators. The other variables of the model were valid and reliably measured.

The results support the fact that a more successful EDI system design can be explained by a higher level of design management. It implies that EDI projects with a higher level of design management come up with a more successful EDI system design in terms of realizing their planned quality, costs and delivery time. Four factors could be distinguished which represent the level of design management. These factors are *level of process management*, *attention to aspects of the EDI system*, *relation with top management*, and *relation between designers and users*. It seems that EDI projects with a higher level of design management have more time for real design activities, in which creativity, flexibility, and innovation play an important role, evaluate in a more systematic way and therefore learn more in terms of possibilities and desirabilities of EDI and the EDI system, its design activities, and the way those activities should be managed. EDI projects with a low level of design management demonstrate the limited rationality which brings managers, designers and users to the decision-making process which leads to '*muddling with a purpose*'. The results support the fact that a higher level of design management is explained by a more specified cooperation contract between the organizations.

The results also support the hypothesis that a more specified cooperation contract can be explained by a higher level of contracting management. Two factors could be distinguished which represent the level of contracting management. These factors are *level of strategic behaviour* and *level of dependency*. It seems that organizations in a project with a higher level of contracting management behave more strategically, and are more aware of the possibilities, costs and benefits of EDI and its implications. The EDI strategy is derived from the strategic plans of the organizations. EDI projects with a low level of contracting management show uncertainty about their strategic choice or did not make a strategic choice at all. This might be caused by the lack of involvement of general managers in the contracting process. These organizations are more resource-dependent, that is more dependent on their suppliers or buyers. The results show the importance of the *strategic choice perspective* and the contingency perspective in particular the *resource dependency view*.

The results related to contracting management become very relevant because the results strongly support the direct effect of the level of contracting management on EDI system-design success.

There was some support for the hypothesis that the level of contracting management is positively affected by the level of cooperativeness of the sector. EDI projects in which EDI or branch organizations were involved during the contracting process showed a higher level of contracting management. It seems that those EDI/branch organizations provide knowledge about the scope for EDI in the sector, sometimes in terms of standardized EDI messages, provide knowledge about how to manage those interorganizational processes, in the case of branch organizations provide awareness and support from their representatives to develop an EDI system.

No support is found for the hypothesis that EDI system-design success is positively affected by the level of specification of the cooperation contract. In the survey it was reported that few EDI projects specified the EDI system design in terms of quality, costs, and delivery time, in their cooperation contract. No support is found either in the survey research or the case study, for the hypothesis that the level of design management was positively affected by the level of stableness of the design environment. It was reported that in most cases the environment of the EDI project was rather turbulent. But this does not seem to influence the level of design management directly in a positive or negative way.

It was reported in the case study that for the construct 'contracting environment' the variable level of competition with other EDI platforms might be useful. It seems that the level of contracting management is positively affected by the level of competition with other EDI platforms. This hypothesis must be tested empirically. It was also reported in the case study that for the construct 'design environment' the variable level of involvement of EDI software providers might positively affect the level of design management. This hypothesis must also be tested empirically.

Additional results

Within the survey attention was paid to the EDI system implemented. EDI system-implementation success was defined and measured as the way the realized implemented EDI system meets the planned requirements. There was strong support for the hypothesis that EDI system-implementation success is positively affected by EDI system-design success. It seems that EDI projects which come up with a more successful EDI system design in terms of realizing their planned quality, costs and delivery time, will also result in a more successfully implemented EDI system. It shows that a preliminary conclusion might be that it is *not* only implementation which is the key to successful information systems (Lucas 1981), but contracting.

Discussion of research approaches used

One of the strengths of this study was that a quantitative (the survey) and a qualitative (the case study) research approach was used. The strength of the survey is its clear definition of variables and indicators and the (statistical) generalization provided. The strength of the case study is its ability to capture 'reality' in considerably greater detail. There were some weaknesses related to the data collection of the survey data. These weaknesses were:

- The selection of EDI projects was not done randomly, EDI projects were selected on the basis of having finished their design process;
- The 35 EDI projects investigated were a small sample for statistical analysis;
- Only the project manager was interviewed. To lessen the bias a measuring instrument was developed which measured objective and subjective success. The advantage of asking the project manager was to get more detailed information related to all the variables of the research model.

Obviously, in light of these weaknesses one has to be cautious in using the results of this study.

Generality of the results
This study focused on one subset of interorganizational information systems e.g. EDI systems. The unit of analysis is the EDI project. The research model was specified for the design of EDI systems. For each EDI project, for example, the quality of the EDI system design was measured and other variables like the level of contracting management and design management were characterized. Elements of the level of design management dealt with typical EDI system design activities like EDI software and EDI message standardization. Therefore, one can not conclude that the results of this study can easily be generalized to extend to inter-organizational information systems or even intra-organizational information systems. The foundation of the research model and the ideas behind the research model can easily be used to develop a research model for the design management of another subset of information systems in a specific problem context.

Implications of the Design Management Theory
The research model is of theoretical importance. The Design Management Theory provides insight into the contracting and design process of EDI systems. The research model partly explains the success of EDI system design. It is based on constructs from the Decision-making and Environmental school. There were no previous reports of research on this subject. Research in the science of Information Management has focused on intra-organizational information systems and within these systems, mainly on the implementation process. This study moved towards inter-organizational information systems and the contracting and design process of those systems.

The research model might prove important from a theoretical point of view. The results indicated the strengths of the Decision-making school in particular the disjointed incrementalistic view of the rational perspective. The results indicated the strengths of the Environmental school, in particular the resource dependency view of the contingency perspective and the strategic choice perspective. The weaknesses of the Environmental school are related to the lack of functional relationships between environment and management variables. In organizational and information systems' literature, these relationships are investigated extensively. More attention must be paid in the future to the interaction relationship between environment and management.

The research model might prove important from a practical point of view. Although the objective of this study was to describe the design process of EDI systems, its conclusions might be useful for practitioners. For example, the dominance of contracting management on EDI system-design success, the relation between design management and EDI system-design success, the relation between the three dimensions (quality, costs and time) of the EDI system design, and the specification of the quality of the EDI system design might be useful. But the conclusions of this study are not prescriptive and do not provide recommendations for the design of EDI systems. There are two objections to the presentation of recommendations for improving the functioning of EDI projects. This study follows the line of argumentation put forward by Frissen (1989). The first argument deals with the fact that the prediction of social development is excluded on methodological grounds. At this time, the science of Information Management has no strong theories to argue in favour of those interventions in reality. The second argument deals with the normative basis of a science when it is concentrated on recommendations. The improvement of the functioning of EDI project implicates norms. Science cannot provide those norms, only make those norms the object of research. Frissen (1989) argues that recommendations are primarily based on the definition of a situation and, as such, are not an application of scientific insight, but of symbolic interaction.

Science implicates independency and distance. This does not exclude the fact that theory might play a role in everyday practice. Huber (1990) notes that the relative newness and volatility of the new technologies means that inevitably managers will not have sufficient past experience to rely on when making key decisions about technology implementation. Without experience as a guide, where do managers turn? Among the favoured options is theory - theory which is both relevant and accessible. The role of relevance as a criterion for evaluating organizational theories is stressed by Weick (1987:105), who elaborates upon five properties of relevance: descriptive relevance (address issues and phenomena that practitioners actually encounter), goal relevance (the outcomes of interest are addressed by theories), operational validity (causal variables can be somewhat controlled by practitioners), non-obvious (theories exceed the complexity of common sense knowledge already used by practitioners). Related to the Design Management Theory, these five properties of relevance are:

- In practice, managers face problems when discussing design management aspects in an interorganizational context (descriptive relevance);
- The goals defined in the research model (quality, costs and time dimension) are the goals project managers of EDI projects deal with (goal relevance);

- The research model is operationalized in such a form that the variables like contracting and design management and EDI system-design success can be controlled by practitioners (operational validity);
- The research model presents new knowledge with regard to the design management of EDI systems (non-obvious).

This study showed that the Design Management Theory for EDI systems is falsifiable and useful in explaining the success or failure of EDI system design.

9.3 Suggestions for further research

Also at the end of this study there is the feeling, as John Wheeler once said, that 'we live on an island of knowledge surrounded by a sea of ignorance. As our island of knowledge grows, so does the shore of our ignorance'. This study ends by presenting some suggestions for future research related to the science of Information Management. If this field is to grow to a more mature level, research must focus on falsifiable and useful prescriptive *and* descriptive models. In the coming years more time must be invested in sound descriptive models. Four objects of research will be distinguished: contracting management, quality of EDI system design, lean production and EDI, and design of electronic markets.

Contracting Management

In the Design Management Theory a strong relationship was indicated between the level of contracting management and EDI system-design success. Less knowledge in the field of Information Management is available on how this contracting process is carried out in detail. Within the framework suggested, other variables might be suggested related to 'level of strategic behaviour' and 'level of dependency' and under which conditions these variables exist. It was indicated that the variable level of competition with other EDI platforms might be useful. The contracting process will become more important. Fundamental issues of organizational identity, managerial practices and market strategy become urgent policy questions as information technologies transform organizational boundaries and relationships in the market (Konsynski 1992). General managers have to think about linking their organization with others. This interorganizational thinking process is what this study calls the contracting process. What initiatives are taken and by whom? Which arguments are used to link up with whom? What implications are to be expected as a result of these links? What sort of contracts have to be concluded and with whom? Those questions could be investigated in more detail in future research.

Quality of EDI system design

This study has tried to measure the quality of EDI systems. In general, measuring quality related to system design is new in the field of Information Management. Quantitative research has focused on perceived quality/information satisfaction of implemented information systems. In the survey the realized and planned quality of EDI system design was measured as perceived by the project manager. Two lines of research are suggested. The first one is in general to focus on the quality of design related to research on product quality. In this case the quality perception process of users of information systems could be investigated, using for example the model developed by Steenkamp (1989). The second line deals with the investigation of the perception of different groups (managers, designers, users) in the development process related to the quality of the EDI system.

Lean production and EDI

In most EDI projects a strong relationship between logistics and EDI was assumed. For example in the development of logistical information systems one deals with the flow of goods and the integral management of these flows. A sound descriptive model of those flows and the information management related to those flows is necessary. A relation with logistical concepts like *lean production* is worthwhile investigating. For the lean production concept an excellent study is presented by Womack et al. (1991). Descriptive models related to animation/simulation and computer graphics of those situations seem to be successful, see for example Streng and Sol (1992) for this approach to EDI research.

Design of electronic markets

In the EDI Flower case study one of the extremely interesting areas deals with the effect of information technology (IT), like EDI and multi-media technologies, on price information and the flower auction process itself. New technologies will also have an effect on strategic positions of the flower growers, the auctions, the buyers and retailers. Research related to the design of computerized markets come to mind, see for example Smith and Williams (1992). Questions like what is the effect of IT on price information dissemination and the efficiency of the market? Under what conditions are those electronic markets efficient? What are relevant design criteria for electronic markets? In the future more attention will be paid to these questions.

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Design activities.
The execution part of the design process.

Design environment.
External variables which have a functional relationship with the design management within an EDI project.

Design management.
Decision-making dealing with the initiation, direction and control of design activities.

Design process.
The course of design management and design activities resulting in an EDI system design. The input of the design process is the cooperation contract. The output of the design process is the EDI system design.

EDI.
Electronic Data Interchange. The electronic interchange of structured and normative data between computers of transaction-related organizations.

EDIFACT.
Electronic Data Interchange For Administration, Commerce and Transport. An international standard for EDI messages. It embodies rules, recommendations, norms and data definitions.

EDI project.
The interorganizational collection of resources to develop and implement a unique EDI system.

EDI system.
A business facility for the electronic exchange of structured and normative data between computers of transaction-related organizations.

EDI system design.
An architecture model or a formal specification of an EDI system.

EDI system-design success.
The way the realized EDI system design meets the planned requirements.

GLOSSARY OF TERMS

Contingency management.
Management concerned with the relationship between relevant environmental variables and appropriate management concepts and techniques.

Contracting activities.
The execution part of the contracting process.

Contracting environment.
External variables which have a functional relationship with the contracting management within an EDI project.

Contracting management.
Decision-making dealing with the initiation, direction and control of contracting activities.

Contracting process.
The course of contracting management and contracting activities resulting in a cooperation contract related to the development of an EDI system between transactions-related organizations. The input of the contracting process is the initiative taken by one or more organizations. The output of the contracting process is the cooperation contract.

Contracting success.
The level of specification of the cooperation contract.

EDI system-implementation success.
The way the realized implemented EDI system meets the planned requirements.

Information system.
A business facility consisting of hardware, software, data, people and procedures, which provide information for one or more organizations.

Interorganizational information system.
Information systems that are jointly developed, operated and/or used by two or more organizations that have no joint executive.

Level of cooperativeness of the contracting environment.
The way organizations in a sector, related to the EDI project, are working together.

Level of contracting management.
The way decision-making dealing with the initiation, direction and control of contracting activities is controlled and measured.

Level of design management.
The way decision-making dealing with the initiation, direction and control of design activities is controlled and measured.

Level of stability of the design environment.
The amount of turbulence and uncertainty with regard to the organizations in the EDI project.

Model.
A description of a real or hypothetical system which is used to understand and sometimes explain or predict its behavior. A model is mostly a simplified description of a system.

Pragmatics.
Aspect of information dealing with the effects or result of using information.

Semantics.
An aspect of information dealing with the objective meaning of data.

Syntax.
An aspect of information dealing with the rules which are used to communicate in a proper way.

System.
A complex entity of which the components are interdependent, identified by a person for a certain objective.

ABSTRACT

DESIGN MANAGEMENT OF EDI SYSTEMS

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This study deals with the management of the design process of Electronic Data Interchange (EDI) systems. Its objectives are (1) to investigate the design process of EDI systems from a practical and theoretical perspective; (2) to develop a model to describe factors relevant to EDI system-design success; (3) to investigate the proposed model empirically. The model to be developed is called the Design Management Theory for EDI systems. Characteristics of EDI systems and two relevant schools within organization theory e.g. the Decision-making school and the Environmental school provide a foundation for the Design Management Theory for EDI systems. Propositions are formulated around the constructs EDI system-design success, design management, design environment, contracting success, contracting management, and contracting environment. Variables and hypotheses are defined. The Design Management Theory is investigated empirically by quantitative and qualitative measures. The quantitative approach uses the survey data of 35 Dutch EDI projects. Survey data were analysed by multi-variate analysis methods. The qualitative approach uses a case study of one EDI project, the EDI Flower project, and analytic induction of the case study data. The results indicate that the Design Management Theory partly explains the success of EDI system design. Higher levels of contracting management, contracting success, and design management cause a more successful EDI system design. Relevant factors with regard to contracting management and design management were distinguished. The results indicate the strengths of the Decision-making school in particular the disjointed incrementalistic view of the rational perspective. The results indicate the strengths of the Environmental school, in particular the resource dependency view of the contingency perspective and the strategic choice perspective. Improvements were suggested for the theory related to the specification of EDI system-design success, design environment and contracting environment.

SAMENVATTING

ONTWERPMANAGEMENT VAN EDI SYSTEMEN

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Introductie
Deze studie heeft als onderwerp de besturing van het ontwerpen van Electronic Data Interchange (EDI) systemen. De studie start in hoofdstuk 1 met de constatering dat ontwerpen een van de meest fascinerende menselijke activiteiten is. Architecten ontwerpen wolkenkrabbers, componisten ontwerpen hun symfonieën, de ingenieur ontwerpt een compact disk en de systeem architect ontwerpt een informatiesysteem. Ontwerpen als proces kan worden gedefinieerd als het creëren, vormen, uitvoeren of construeren volgens een plan. Het ontwerp, als produkt van het ontwerpproces, wordt gedefinieerd als een voorlopige schets of samenvatting die de belangrijkste eigenschappen laat zien van iets dat uitgevoerd wordt.

Alhoewel ontwerpen een van de meest fascinerende menselijke activiteiten is lijkt het ook een van de minst te begrijpen activiteiten. Hoe is het creatieve idee ontstaan voor het ontwerp van het Empire State gebouw, waarom ontwierp Mozart zijn prachtige symfonieën, hoe ontwierp de anonieme ingenieur de compact disk, hoe ontwerpen systeem architecten informatiesystemen, waarom is het ene ontwerp mooier, beter, meer bruikbaar dan een ander ontwerp? Onder deze vragen liggen andere vragen zoals: kunnen we creatieve ideeën stimuleren, is het mogelijk om ontwerpactiviteiten te initiëren, richting te geven en te beheersen, als we deze activiteiten besturen verliezen we dan onze creativiteit en raken we verwikkeld in bureaucratie? In deze studie zullen we trachten antwoorden te vinden op dit type vragen door theorie en praktijk te onderzoeken.

Deze studie gaat over het ontwerpproces en het produkt van het ontwerpproces van EDI systemen i.c. het EDI systeemontwerp. Een EDI systeem is een faciliteit die zorgt voor de elektronische communicatie van gestructureerde en normatieve gegevens tussen computers van transactie-gerelateerde organisaties. De afgelopen jaren is een sterke groei geconstateerd in het aantal EDI systemen dat in ontwikkeling is. In de praktijk blijkt dat het ontwikkelen van EDI systemen geen eenvoudige zaak is. Vele organisaties, met ieder hun eigen vocabulair en semantiek, communiceren met elkaar in een project. Hierbij lijkt het besturen van het ontwerpproces een belangrijk aangrijpingspunt om het succes of falen van het EDI systeemontwerp te kunnen verklaren.

In deze studie wordt het onderwerp ook vanuit een theoretisch perspectief belicht. Theoretische concepten vanuit de organisatie theorie worden hierbij gebruikt. Ten eerste wordt de vraag gesteld: kan ontwerpen begrepen worden vanuit een besluitvormingsperspectief? De stroming die zich bezig houdt met deze vraag noemen we de Besluitvormingsschool. Deze school gaat ervan uit dat individuen en organisaties zich gedragen op een procedureel rationele wijze. De tweede die wordt gesteld is: kan ontwerpen begrepen worden vanuit de omgeving of context waarin het ontwerpen heeft plaats gevonden? De stroming die zich bezig houdt met deze vraag noemen we de Omgevingsschool. In deze school wordt besluitvorming uitgebreid tot besturing en gedefinieerd als het initiëren, richten en beheersen van doelgerichte activiteiten. De Omgevingsschool concentreert zich op de relatie tussen omgevingsvariabelen en geschikte besturingsconcepten en -technieken, die leiden tot effectieve doelbereiking.

In deze studie zal een theorie ontwikkeld worden die beschrijvend van karakter is en inzicht geeft in de besturing van het ontwerpproces van EDI systemen. Deze studie poogt antwoorden te formuleren op de volgende drie centrale vragen:

- Welke factoren zijn verantwoordelijk voor het succes of falen van het EDI systeemontwerp?
- Hoe zijn deze factoren verantwoordelijk voor het succes en falen van het EDI systeemontwerp?
- Waarom zijn deze factoren verantwoordelijk voor het succes of falen van het EDI systeemontwerp?

Deze studie beoogt drie doelen te bereiken:

- Het vanuit een praktische en theoretische invalshoek onderzoeken van het ontwerpproces van EDI systemen;

. Het ontwikkelen van een onderzoeksmodel dat factoren beschrijft die relevant zijn voor het succes of falen van het EDI systeemontwerp;
. Het empirische toetsen van het voorgestelde model.

Het in deze studie ontwikkelde onderzoeksmodel wordt de Ontwerp Management Theorie ('*Design Management Theory*') van EDI systemen genoemd. Deze theorie is beschrijvend van aard en poogt een bijdrage te leveren aan het inzichtelijk maken van de besturing van het ontwerpproces van EDI systemen. Deze studie richt zich met name op het ontwerpproces van EDI systemen in projecten.

De studie volgt de empirische cyclus. Deze cyclus beschrijft een wetenschappelijk verantwoorde methode voor het vergaren en gebruiken van kennis en inzicht. De studie en het boek bestaan uit drie delen. Deel 1 ('*bouwen van de theorie*') betreft het ontwikkelen van de theorie en bestaat uit drie hoofdstukken. Deel 2 ('*toetsen van de theorie*') betreft het beproeven van de theorie en bestaat ook uit drie hoofdstukken. In Deel 3 ('*interpretatie en perspectief*') wordt ingegaan op de interpretatie van de resultaten en wordt een perspectief geschetst. Het derde deel bestaat uit twee hoofdstukken. De delen en hun hoofdstukken zullen hierna worden samengevat.

Deel 1 Bouwen van de theorie

In het eerste deel wordt vanuit een praktische en een theoretische invalshoek een theorie ontwikkeld die, na toetsing, een antwoord dient te geven op de, in het voorgaande gestelde, centrale vragen.

Karakteristieken van EDI systemen

In hoofdstuk 2 wordt vanuit een praktische invalshoek aandacht besteed aan de definitie van EDI en EDI systeem. Een EDI systeem wordt gezien als een bepaald type inter-organisationeel informatiesysteem. Het kenmerkende hierbij is dat een EDI systeem op een min of meer automatische wijze elektronische berichten uitwisselt tussen transactie-gerelateerde organisaties. In deze elektronische berichten staan gestructureerde en genormeerde gegevens. In de praktijk zijn er verschillende redenen te onderkennen om zulke EDI systemen te ontwikkelen en installeren. Deze redenen zijn onder te verdelen naar hun doelgerichtheid: strategisch/effectiviteit versus efficiency. In het eerste geval gaat het, door het gebruiken van een EDI systeem, om het verkrijgen van nieuwe produkten en/of markten. In het tweede geval gaat het om het verbeteren van de interorganisationele communicatie, het reduceren van de administratie kosten en voorraad kosten. Binnen een EDI systeem worden een vijftal te onderscheiden elementen onderkend: het technologisch element, het software element, het gegevens element, het gebruikers element en het organisatorisch element. In de praktijk blijkt de specificatie van de kwaliteit van een EDI systeem een toenemende aandacht te krijgen. Vanuit de produktie management benadering en de kwaliteitsperceptie benadering wordt nader in gegaan op de kwaliteit van een EDI systeem. Dynamische en statische kwaliteitsattributen van een EDI systeem worden gespecificeerd. Ten slotte wordt in hoofdstuk 2 nagegaan op welke wijze in de praktijk EDI systemen worden ontwikkeld. Hieruit blijkt in het algemeen dat ontwikkelingsmethoden met betrekking tot EDI systemen project-georiënteerd zijn, dat zij de levenscyclus van een informatiesysteem volgen, dat zij onderscheid maken in processen en produkten binnen de cyclus, dat veel aandacht wordt geschonken aan strategische aspecten van EDI systemen en dat zij starten met de definitie van proefprojecten.

Theorieën over besluitvorming en omgeving

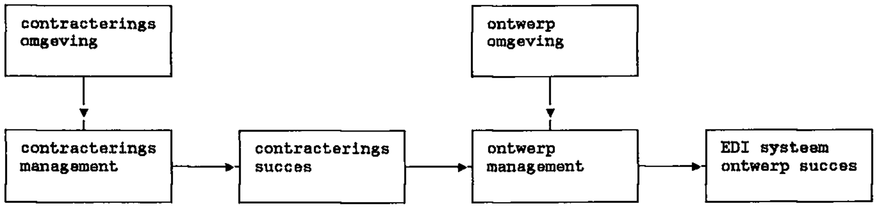
In hoofdstuk 3 wordt het probleem vanuit een theoretische invalshoek benaderd. In het hoofdstuk staan twee vragen centraal. De eerste vraag is: kan ontwerpen begrepen worden vanuit een besluitvormingsperspectief? Deze vraag wordt beantwoord door middel van een literatuuronderzoek naar de verschillende benaderingen binnen de Besluitvormingsschool ('Decision-making school'). Er worden drie benaderingen in de Besluitvormingsschool onderscheiden: de rationele benadering, de politieke benadering en de zogenoemde vuilnis-bak benadering. Vanuit de Besluitvormingsschool kan ontwerpen worden gezien als ontdekken en uitwerken van alternatieven. Actoren in een besluitvormingsproces gedragen zich veelal procedureel rationeel. Dat wil zeggen dat de effectiviteit van het besluitvormingsproces met name afhankelijk is van de gekozen procedures die geleid hebben tot de genomen besluiten. Deze keuze van procedurele rationaliteit impliceert dat beschrijvende modellen van ontwerpproblemen en ontwerpprocessen het meest bruikbaar zijn. Besluitvormingsprocessen verlopen niet altijd ordelijk en worden sterk beïnvloed door de distributie van macht in en rond organisaties. De uitkomst van een besluitvormingsproces lijkt soms afhankelijk van vier relatief onafhankelijke elementen: problemen, oplossingen, participanten en mogelijkheden.

De tweede vraag in hoofdstuk 3 spitst zich toe op de relatie tussen management en omgeving. De vraag is: kan ontwerpen begrepen worden vanuit de omgeving of context waarin het ontwerpen heeft plaats gevonden? Deze vraag wordt beantwoord door middel van een literatuuronderzoek naar de verschillende benaderingen binnen de Omgevingsschool ('Environmental school'). Er worden binnen de Omgevingsschool drie benaderingen onderscheiden: de contingency benadering, de strategische keuze benadering en de consistentie benadering. In de Omgevingsschool staat de functionele relatie tussen de omgeving en het management van een organisatie centraal. Dit betekent dat in een bepaalde omgevingscontext een bepaalde management configuratie past zodanig dat deze leidt tot het effectief bereiken van doelen. Gerelateerd aan het ontwerpproces van EDI systemen is het van belang om de omgeving van het ontwerpproces in ogenschouw te nemen. Tevens blijkt dat het strategisch besluitvormingsproces van de dominante coalities een belangrijke rol speelt. Uit het literatuur onderzoek blijkt tevens dat bij het gebruik van constructies uit de Omgevingsschool aandacht moet worden geschonken aan het zorgvuldig kiezen van de onderzoeksbenaderingen en het onderzoeksmateriaal.

Ontwerp Management Theorie

In hoofdstuk 4 worden elementen uit de praktijk en de Besluitvormings- en Omgevingsschool geïntegreerd tot een Ontwerp Management Theorie voor EDI systemen. In deze theorie wordt onderscheid gemaakt (1) tussen het contracteringsproces en het ontwerpproces, (2) tussen management en uitvoering en (3) tussen management en omgeving. Het resultaat van het contracteringsproces is het samenwerkingscontract. Het resultaat van het ontwerpproces is het EDI systeemontwerp. De Ontwerp Management Theorie bestaat uit zes constructies: contracteringsomgeving, contracteringsmanagement, contracteringssucces, ontwerpomgeving, ontwerpmanagement en EDI systeemontwerp succes. De relaties tussen deze zes constructies worden in figuur 1 weergegeven.

Het EDI systeemontwerp succes wordt gedefinieerd als de mate waarin het gerealiseerde EDI systeemontwerp aan de geplande eisen tegemoet komt. Ontwerpmanagement wordt gedefinieerd als besluitvorming met betrekking tot het initiëren, richten en beheersen van ontwerpactiviteiten. Ontwerpomgeving wordt gedefinieerd als die externe variabelen die een functionele relatie hebben met het ontwerpmanagement van een EDI project.



Figuur 1: Ontwerp Management Theorie voor EDI systemen.

Contracteringssucces wordt gedefinieerd als de mate van specificatie van het samenwerkingscontract. Contracteringsmanagement wordt gedefinieerd als besluitvorming met betrekking tot het initiëren, richten en beheersen van contracteringsactiviteiten. Contracteringsomgeving wordt gedefinieerd als die externe variabelen die een functionele relatie hebben met het contracteringsmanagement van een EDI project.

Er worden twee proposities binnen de Ontwerp Management Theorie onderscheiden:

(1) Het contracteringssucces wordt bepaald door het contracteringsmanagement en de contracteringsomgeving;
(2) Het succes van het EDI systeemontwerp wordt bepaald door het ontwerpmanagement, de ontwerpomgeving en het contracteringssucces.

De zes constructies en twee proposities worden verder verfijnd in variabelen en hypothesen. Bij deze verfijning wordt gebruik gemaakt van additionele literatuur met betrekking tot onderzoek op het gebied van informatiesystemen. Deze hypothesen zijn meetbaar en kunnen dus empirisch worden getoetst.

Deel 2 Toetsen van de theorie

In het tweede deel wordt de Ontwerp Management Theorie getoetst. Dit gebeurt op zowel kwantitatieve als op kwalitatieve wijze. De kwantitatieve benadering maakt gebruik van een enquête-onderzoek binnen EDI projecten en multivariate analyse methoden. De kwalitatieve benadering maakt gebruik van een gevalstudie van een EDI project, het EDI Flower project, en analytische inductie.

Enquête-onderzoek binnen EDI projecten
In hoofdstuk 5 wordt de kwantitatieve benadering verder uitgewerkt. De ontwikkelde theorie is empirisch onderzocht middels een enquête-onderzoek onder 35 projectleiders van 35 EDI projecten. Ten behoeve van de enquête is een vragenlijst ontwikkeld en deze is gebruikt in een gestructureerd interview van de projectleider van het desbetreffende EDI project. Voordelen van deze gestructureerde interview aanpak zijn dat moeilijker vragen kunnen worden gesteld, dat antwoorden kunnen worden geverifieerd door open vragen en dat interpretatieproblemen kunnen worden verminderd. Vijftig EDI projecten werden geselecteerd uit de totale populatie van 91 Nederlandse EDI projecten. Het selectiecriterium was dat het EDI project recent het ontwerpproces had afgesloten. Uiteindelijk waren de resultaten van 35 EDI projecten bruikbaar. De volgende argumenten speelden een rol bij het besluit om projectleiders te interviewen:

- Projectleiders kunnen een indicatie geven over het niveau van het resultaat van het ontwerpproces i.c. het EDI systeemontwerp in termen van kwaliteit, kosten en levertijdstip;
- Projectleiders kunnen een indicatie geven over het niveau van het resultaat van het contracteringsproces i.c. de mate van specificatie van het samenwerkingscontract;
- Projectleiders kunnen een indicatie geven over het niveau van samenwerking van de contracteringsomgeving, het niveau van contracteringsmanagement, het niveau van stabiliteit van de ontwerpomgeving en het niveau van het ontwerpmanagement;
- Projectleiders van verschillende EDI projecten zijn vergelijkbaar in de zin dat hun positie in termen van functie en activiteiten min of meer overeenkomstig is.

De zwakheid van deze onderzoeksbenadering ligt in de vooroordelen van projectleiders. Het resultaat van het EDI project is immers in sterke mate gerelateerd aan de positie en status van de projectleider. Daarom is gekozen om een zo objectief mogelijk meetinstrument te ontwerpen met betrekking tot contracteringssucces en het succes van het EDI systeemontwerp en om zo nauwkeurig mogelijk de niveaus van de contracteringsomgeving, het contracteringsmanagement, de ontwerpomgeving en het ontwerpmanagement te specificeren. Tenslotte is ervan uitgegaan dat de vooroordelen van de projectleiders voor alle EDI projecten in dezelfde richting verliepen en dat de relatieve waarde van de model variabelen van het EDI project van belang is.

De vragenlijst is getoetst op validiteit en betrouwbaarheid. Validiteit werd getoetst door het vaststellen van de begrips-, criterium- en constructvaliditeit. Hierdoor werd de vragenlijst op enkele punten gewijzigd. Betrouwbaarheid werd getoetst door middel van het bepalen van de interne consistentie middels het berekenen van Cronbach's alpha coëfficiënten en correlatie coëfficiënten. De variabelen contracteringsmanagement, contracteringssucces, ontwerpomgeving, ontwerpmanagement en EDI systeemontwerp succes blijken intern consistent en daarmee betrouwbaar gemeten. De variabele met betrekking tot de contracteringsomgeving blijkt intern niet consistent. Nader onderzoek naar nieuwe indicatoren voor deze variabele wordt in hoofdstuk 7 uitgevoerd.

Analyse van de enquêtegegevens

In hoofdstuk 6 worden de gegevens van de enquête gepresenteerd en geanalyseerd. De belangrijkste resultaten zijn:

. In 11 van de 35 EDI projecten is geen samenwerkingscontract gespecificeerd voor het begin van het ontwerpproces;
. Van de 22 EDI projecten die wel een samenwerkingscontract hebben gespecificeerd blijkt met name de verantwoordelijkheden van de gecontracteerden en de opdrachtgever, de kosten van het EDI systeemontwerp en het te implementeren EDI systeem en de aansprakelijkheid van de gecontracteerden te zijn gespecificeerd. Aspecten als boetes gerelateerd aan produktkwaliteit-, kosten- en levertijdoverschrijding, winstvaststelling en winstbestemming tussen deelnemers blijken veelal niet gespecificeerd.
. In 3 van de 35 EDI projecten eindigt het ontwerpproces niet in een gespecificeerd EDI systeemontwerp. In 4 projecten is het niet mogelijk de dimensies kwaliteit, kosten en levertijdstip van het EDI systeemontwerp te meten. Voor 28 projecten is het mogelijk de mate van succes van het EDI systeemontwerp te bepalen. Hieruit blijkt dat in geen van de projecten de gerealiseerde kwaliteit, kosten en levertijdstip van het EDI systeemontwerp overeenkomen met de geplande.

Door middel van multi-variate analyse methoden zijn de enquête gegevens verder geanalyseerd en de hypothesen getoetst. De belangrijkste resultaten zijn:

. Een succesvoller EDI systeemontwerp kan worden verklaard door een hoger niveau van ontwerpmanagement. Dit impliceert dat EDI projecten met een hoger niveau van ontwerpmanagement resulteren in een succesvoller EDI systeemontwerp in termen van gerealiseerde kwaliteit, kosten en levertijdstip.

. Vier factoren kunnen worden onderscheiden die binnen het ontwerpmanagement van belang zijn. Deze factoren zijn het niveau van het procesmanagement, de mate van aandacht voor de elementen van het EDI systeem, de relatie met het top management en de relatie tussen ontwerpers en gebruikers. Het ziet er naar uit dat EDI projecten met een hoger niveau van ontwerpmanagement meer tijd hebben voor echte ontwerpactiviteiten waarin creativiteit, flexibiliteit, en innovatie een belangrijke rol spelen. In deze projecten wordt op een systematische wijze geëvalueerd en daarom leren projectmedewerkers meer in termen van wenselijkheden en mogelijkheden van EDI, EDI systemen, de ontwerpactiviteiten en de mate waarin deze ontwerpactiviteiten kunnen worden bestuurd. EDI projecten met een laag niveau van ontwerpmanagement demonstreren de beperkte rationaliteit ten aanzien van besluitvorming van managers, ontwerpers en gebruikers. Dit is ook wel te karakteriseren als 'doormodderen met een doel'.

. De resultaten laten zien dat een hoog niveau van ontwerpmanagement wordt verklaard door een meer gespecificeerd samenwerkingscontract tussen de betrokken organisaties.

. De resultaten laten eveneens zien dat een meer gespecificeerd samenwerkingscontract verklaard kan worden door een hoger niveau van contracteringsmanagement.

. Twee factoren kunnen worden onderscheiden die binnen het contracteringsmanagement van belang zijn. Deze factoren zijn het niveau van het strategische gedrag en de mate van afhankelijkheid. Het lijkt erop dat organisaties in een project met een hoger niveau van contracterings-management zich strategischer gedragen en zich meer bewust zijn van de mogelijkheden, kosten, baten en implicaties van EDI. In deze gevallen is de EDI strategie afgeleid van de strategische plannen van de participerende organisaties. Projecten met een laag niveau van ontwerpmanagement vertonen onzekerheid over hun strategische keuzen of hebben überhaupt geen strategische keuzen gemaakt. Organisaties in projecten met een hoog niveau van contracteringsmanagement zijn meer afhankelijk van elkaar in termen van toe te leveren of af te nemen hulpbronnen. De resultaten laten het belang zien van de contingency benadering en de strategische keuze benadering.

- Het belang van het niveau van het contracteringsmanagement wordt nog eens onderstreept door de sterke relatie die gevonden is tussen het niveau van contracteringsmanagement en het succes van het EDI systeemontwerp.
- Uit de resultaten van deze studie blijkt eveneens dat het niveau van contracteringsmanagement positief gerelateerd is aan de mate waarop EDI en/of branche organisaties betrokken zijn in het contracteringsproces. Het lijkt erop dat deze organisaties kennis, betrokkenheid en ondersteuning leveren, soms in de vorm van gestandaardiseerde EDI berichten.
- Er is geen ondersteuning gevonden voor de hypothese met betrekking tot de positieve relatie tussen contracteringssucces i.c. de mate van specificatie van het samenwerkingscontract en het succes van het EDI systeemontwerp. Uit het onderzoek blijkt dat bij weinig projecten het EDI systeemontwerp in termen van geplande kwaliteit, kosten en levertijdstip is gespecificeerd in het samenwerkingscontract.
- Er is ook geen ondersteuning gevonden voor de hypothese dat het niveau van ontwerpmanagement positief wordt beïnvloed door de mate van stabiliteit van de ontwerpomgeving. In de meeste onderzochte projecten is er sprake van een relatief onstabiele ontwerpomgeving. Echter er lijkt geen invloed, zowel in positieve als in negatieve zin, te zijn op het niveau van het ontwerpmanagement.

Tenslotte zijn de enquêtegegevens met betrekking tot het implementatie succes van het EDI systeem nader geanalyseerd. De belangrijkste, additionele, resultaten zijn:

- Het succes van het geïmplementeerde EDI systeem is gedefinieerd als de mate waarin de gerealiseerde eisen overeenkomen met de geplande eisen aan het geïmplementeerde EDI systeem. Er is een sterk verband gevonden tussen het succes van het EDI systeemontwerp en het succes van het geïmplementeerde EDI systeem. Het lijkt erop dat projecten die resulteren in een succesvol EDI systeemontwerp, in termen van kwaliteit, kosten, en levertijdstip, uiteindelijk ook resulteren in een succesvol geïmplementeerd EDI systeem. Een voorlopige conclusie zou kunnen zijn dat niet alleen implementatie de sleutel is tot succesvolle informatiesystemen, zoals vaak in de literatuur wordt aangehaald, maar zeker ook contractering en ontwerp.

Hoofdstuk 6 eindigt met een viertal vragen die resteren na de analyse van de enquêtegegevens. Deze vier vragen zijn:

- Waarom verklaart de mate van samenwerking van de contracteringsomgeving slechts een klein gedeelte van de gemeten variatie van het niveau van contracteringsmanagement?
- Waarom heeft het contracteringssucces geen direct of indirect effect op het succes van het EDI systeemontwerp?
- Waarom verklaart het niveau van stabiliteit van de ontwerpomgeving niet de gemeten variatie van het niveau van ontwerp management?
- Waarom verklaart het niveau van ontwerpmanagement slechts een klein gedeelte van de gemeten variatie van het succes van het EDI systeemontwerp?

Deze vragen zullen nader worden onderzocht middels een gevalstudie van het EDI Flower project.

Gevalstudie van het EDI Flower project

In hoofdstuk 7 worden de vragen, opgeroepen door de resultaten van de enquête, op een kwalitatieve wijze onderzocht middels een gevalstudie van het EDI Flower project. Het EDI Flower project is geïnitieerd door de twee grootste bloemenveilingen van Nederland Bloemenveiling Aalsmeer en Bloemenveiling Holland, twee groothandelaren Baardse en Zurel en het Bedrijfsschap voor de Groothandel in Bloemkwekerijprodukten. Begin 1989 werd een proefproject gestart en in de zomer van 1990 werd een vervolgproject opgestart. Het vervolgproject is het aandachtsgebied voor dit onderzoek. Doel van het vervolgproject is het op een praktische manier bereiken van een redelijk volume van elektronische gegevensuitwisseling door eenvoudige en laagdrempelige oplossingen.

De belangrijkste resultaten na analyse van interview- en documentgegevens zijn:

- De mate van samenwerking van de contracteringsomgeving heeft een veel dynamischer karakter dan verwacht. In de gevalstudie blijkt voor de constructie 'contracteringsomgeving' de variabele 'mate van competitie met andere EDI platformen' van belang. Er lijkt een zodanige relatie te zijn dat in een situatie van hogere mate van competitie met andere EDI platformen gerelateerd is aan een hoger niveau van het contracteringsmanagement. Deze hypothese dient nader empirisch te worden getoetst.
- Contracteringssucces blijkt geen relatie te hebben met het succes van het EDI systeemontwerp omdat slechts enkele aspecten van het samenwerkingscontract

op het EDI systeemontwerp slaan. Er kunnen geen nieuwe indicatoren voor zowel contracteringssucces en succes van het EDI systeemontwerp worden onderscheiden.

- Uit de gevalstudie blijkt dat de mate van stabiliteit van de ontwerpomgeving niet herkend kon worden in de gegevens. De ontwerpomgeving is dynamisch en stabiliteit is daardoor moeilijk te meten. Uit de gevalstudie blijkt ook dat voor de constructie 'ontwerpomgeving' de variabele 'mate van betrokkenheid van EDI software leverancier' een positieve relatie heeft met het niveau van het ontwerpmanagement. Deze hypothese zal ook nader empirisch dienen te worden onderzocht.
- De indicator geplande kwaliteitsattributen van het EDI systeemontwerp blijkt moeilijk te meten, omdat deze niet gespecificeerd is in de gevalstudie. De andere indicatoren blijken goed meetbaar. Nieuwe manieren om succes te meten die rekening houden met verschillende ambitieniveaus, veranderende eisen en leerneigingen gedurende het ontwerpproces zouden nog meer licht kunnen werpen op de relatie tussen het niveau van ontwerpmanagement en het succes van het EDI systeemontwerp.

Deel 3 Interpretatie en perspectief

Interpretatie en discussie

In hoofdstuk 8 worden de resultaten van het enquête-onderzoek en de gevalstudie geïnterpreteerd. Voorgesteld wordt om de Design Management Theorie op een drietal punten te verbeteren. Deze punten zijn:

- Niet alleen het meten van het objectieve maar ook van het subjectieve succes van het EDI systeemontwerp. Hierbij zou scherper rekening kunnen worden gehouden met nieuwe eisen in de vorm van kwaliteitsattributen en ambitieniveaus in het ontwerpproces.
- De constructie ontwerpomgeving zou verfijnd kunnen worden in de variabele mate van betrokkenheid van de softwareleverancier. Deze variabele bleek in de gevalstudie een belangrijke omgevingsvariabele die van invloed was op het niveau van het ontwerpmanagement.
- De constructie contracteringsomgeving was verder verfijnd in de variabele mate van mate van samenwerking van de contracteringsomgeving. Deze variabele bleek intern niet consistent. Voorgesteld wordt om twee variabelen te

definiëren: mate van betrokkenheid van EDI/branche organisaties en mate van competitie met andere EDI platformen.

Samenvatting en conclusies

In hoofdstuk 9 tenslotte wordt het onderzoek samengevat en geëvalueerd en worden suggesties voor verder onderzoek gedaan.

Een van de sterke kanten van deze studie is dat zowel kwantitatieve (de enquête) als kwalitatieve (de gevalstudie) onderzoeksmethoden zijn gebruikt. De sterkte van de enquête is dat op een duidelijke wijze de te onderzoeken variabelen en indicatoren dienen te worden gespecificeerd en dat (statistische) generalisatie mogelijk wordt. Er zijn ook enkele zwakten aan te wijzen aan met name de wijze waarop de gegevens zijn verzameld. Deze zijn:

- De EDI projecten zijn geselecteerd en dit is niet willekeurig gedaan. EDI projecten werden geselecteerd op het feit dat zij het ontwerpproces hadden afgerond;
- De 35 onderzochte projecten zijn slechts een klein aantal voor statistische analyse;
- Alleen de projectleider is geïnterviewd. Om de vooringenomenheid van de projectleider te verminderen zijn meetinstrumenten ontwikkeld die zowel objectief als subjectief succes meten. Het voordeel van projectleiders is dat zij over alle variabelen van het onderzoeksmodel informatie kunnen verschaffen.

De sterkte van de gevalstudie is dat de realiteit meer gedetailleerd kan worden beschreven. Echter generalisatie kan hiermee echter niet worden verwezenlijkt. Duidelijk is wel dat in het licht van deze zwakheden men voorzichtig moet zijn met de resultaten van deze studie.

De studie heeft zich geconcentreerd op een deelverzameling van informatiesystemen, namelijk EDI systemen. De analyse eenheid is het EDI project. Het onderzoeksmodel richt zich op het EDI systeemontwerp. Onderdelen van bijvoorbeeld ontwerpmanagement hebben betrekking op typische EDI systeemontwerp activiteiten als EDI software en EDI berichten standaardisatie. Men kan daarom niet stellen dat de resultaten van deze studie eenvoudig zijn te generaliseren naar interorganisationele of zelfs intra-organisationele informatiesystemen. De fundering van het onderzoeksmodel en de ideeën achter het onderzoeksmodel kunnen wel worden gebruikt bij het ontwikkelen van onderzoeksmodel voor het ontwerpmanagment van een andere deelverzameling van informatiesystemen.

Het onderzoeksmodel is van theoretische importantie. De Ontwerp Management Theorie verschaft inzicht in het contracterings- en ontwerpproces van EDI systemen. Het succes van het EDI systeemontwerp wordt voor een deel verklaard. De theorie is gebaseerd op constructies uit de Besluitvormingsschool en de Omgevingsschool. Er zijn geen eerdere studies bekend die betrekking hebben op hetzelfde onderwerp. Onderzoek op het gebied van de Bestuurlijke Informatiekunde heeft veelal betrekking gehad op intra-organisationele informatiesystemen en met name het implementatie proces van deze systemen. In dit onderzoek staan inter-organisationele informatiesystemen centraal en met name het contracterings- en ontwerpproces van deze systemen. De resultaten laten de kracht van de Besluitvormingsschool zien met name de logisch incrementele richting binnen de rationele benadering. De resultaten indiceren de kracht van de Omgevingsschool en met name de richting die zich binnen de contingency benadering bezig houdt met de afhankelijkheid van hulpbronnen van een organisatie ('resource dependency') en de strategische keuze benadering ('strategic choice'). In het onderzoek zijn wel een aantal zwakheden van de Omgevingsschool aan het licht gekomen gerelateerd aan het gebrek van empirisch getoetste functionele relaties tussen omgeving en management. Deze relaties zijn in de organisatie- en informatiesysteemliteratuur al zwak vertegenwoordigd, echter het blijkt dat ze empirisch erg moeilijk zijn aan te tonen. Vooralsnog dient nader onderzoek te worden verricht naar deze interactierelaties tussen omgeving en management.

Vanuit een praktisch oogpunt is het onderzoeksmodel van betekenis. Bijvoorbeeld, de dominantie van contracteringsmanagement op het succes van het EDI systeemontwerp, de relatie tussen ontwerpmanagement en het succes van het EDI systeemontwerp, de relatie tussen de drie dimensies (kwaliteit, kosten, levertijdstip) van het EDI systeemontwerp, en de specificatie van de kwaliteit van het EDI systeemontwerp kunnen bruikbaar zijn. Er worden echter geen specifieke aanbevelingen gedaan voor het verbeteren van het functioneren van EDI projecten.

Tenslotte worden suggesties gedaan voor verder onderzoek. Deze suggesties hebben betrekking op onderzoek naar contracteringsmanagement, de kwaliteit van het EDI systeemontwerp, 'lean production' en EDI en tenslotte het ontwerpen van elektronische markten.

APPENDIX 1 : Questionnaire

ALGEMENE KENMERKEN EDI PROJECT

B1 Wat is de omvang in mensmaanden van het gehele EDI project?

( ) kleiner dan 12 mensmaanden
( ) 12 t/m 48 mensmaanden
( ) 49 t/m 200 mensmaanden
( ) groter dan 200 mensmaanden

B2 Wat is de aard van de sector waar het EDI project betrekking op heeft?

( ) Landbouw en visserij
( ) Industrie
( ) Bouwnijverheid
( ) Handel
( ) Transport en opslag
( ) Bank- en verzekeringswezen
( ) Overige zakelijke dienstverlening
( ) Gezondheidsdiensten
( ) Overheid
( ) Overig

B3 Wat is het aantal bedrijven dat betrokken is bij het EDI project?

( ) 2 bedrijven
( ) 3 - 10 bedrijven
( ) 11 - 25 bedrijven
( ) 26 - 50 bedrijven
( ) 51 - 100 bedrijven
( ) 101 - 250 bedrijven
( ) 251 - 1000 bedrijven
( ) meer dan 1000 bedrijven

B4 In welke proces bevindt het EDI project zich op dit moment?

( ) Initiatieproces
( ) Ontwerpproces
( ) Bouwproces
( ) Implementatieproces
( ) Gebruiks- en beheerproces
( ) Anders, namelijk ....

B5 Hoeveel verschillende soorten berichten worden in het EDI project ontworpen?

( ) één soort bericht
( ) 2 - 4 soorten berichten
( ) 5 - 10 soorten berichten
( ) 11 - 20 soorten berichten
( ) 21 of meer soorten berichten

B6 Welke communicatievorm worden bij de ontwikkelde/te ontwikkelen berichten gehanteerd?

( ) directe communicatie tussen computers
( ) videotex
( ) electronische mailbox
( ) papier
( ) floppy
( ) anders

B7 Welk strategisch doel speelde de belangrijkste rol voor de betrokken partijen om het EDI project te initieren?

( ) identificeren en toegangelijk maken van nieuwe technologieën en vaardigheden
( ) verkrijgen van kennis over en vaardigheden in bestaande technologieën
( ) snel en effectief inspelen op nieuwe mogelijkheden in de markt
( ) snel opbouwen van een marktpositie
( ) opbouwen van continuiteit door middel van specialisatie
( ) nastreven van kritische schaalgrootte
( ) nastreven van kostprijs-leiderschap
( ) terugtrekken uit een bepaalde markt
( ) geen strategisch doel

B8 Wanneer werden de eerste contacten gelegd tussen de partijen in het EDI project?

.... (maand-jaar)

B9 Is het EDI project een proefproject of een vervolgproject?

( ) Proefproject
( ) Vervolgproject

B10 Wat is uw functie in het EDI project?

( ) Opdrachtgever
( ) Projectleider
( ) Deelprojectleider
( ) Lid van een werkgroep
( ) Lid van de stuurgroep
( ) Consultant
( ) Informatie-analist
( ) Systeem-analist
( ) Programmeur
( ) Lijnmanager
( ) Stafmanager
( ) Eind-gebruiker
( ) Systeembeheerder
( ) Anders, namelijk ....

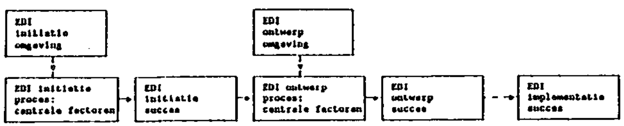
B11 Indien u projectleider van het EDI-project bent, kunt u aangeven welke activiteiten door u als projectleider werden uitgevoerd?

( ) opstellen samenwerkingscontract
( ) inrichten projectorganisatie
( ) planning van het project
( ) budgettering van het project
( ) kwaliteitsbewaking van het project
( ) aantrekken projectmedewerkers
( ) goedkeuren project producten
( ) anders, namelijk ....

Het doorlezen van de nu volgende tekst maakt het mogelijk de volgende vragen snel in te vullen.

Het doel van het onderzoek is om op een systematische wijze inzicht te verkrijgen in de organisatie van de voorbereiding op en het ontwerpen van EDI. De structuur van de enquête is gebaseerd op het hieronder staand model. Er zullen dan ook vragen gesteld worden over elk onderdeel uit het model. De verschillende begrippen in het model hebben we als volgt gedefinieerd:

Onder *Electronic Data Interchange (EDI)* wordt verstaan de elektronische uitwisseling van gestructureerde en genormeerde gegevens tussen computers van bij (handels)transacties betrokken partijen.
Een *EDI project* is het geheel van activiteiten ter realisering van een EDI systeem waarbij het kwaliteitsniveau van het te realiseren EDI systeem is gespecificeerd binnen het gespecificeerde budget en de gespecificeerde oplevertermijn.
Een *EDI systeem* is een bedrijfsmiddel waarmee gestructureerde en genormeerde gegevens worden uitgewisseld tussen computers ten behoeve van het nemen van beslissingen.

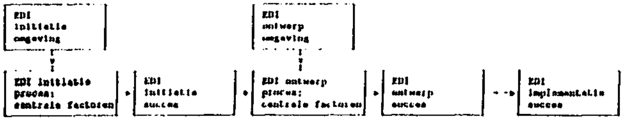


Onder *EDI initiatie omgeving* wordt verstaan die factoren in de omgeving van het initiatieproces die het initiatieproces rechtstreeks beïnvloeden.
Het *EDI initiatieproces* bestaat uit activiteiten die tot doel hebben de samenwerking tussen de betrokken partijen en de eisen ten aanzien van de resultaten van het EDI project vast te leggen in een samenwerkingscontract. Ook wel startfase of voorbereidingsproces genoemd. De besturing van het initatieproces verloopt aan de hand van een aantal centrale factoren. Onder besturing wordt verstaan het initiëren, richten en beheersen van activiteiten, ook wel management of organisatie genoemd.
Onder *EDI initiatie succes* wordt verstaan de mate waarin het samenwerkingscontract is gespecificeerd.
Het *samenwerkingscontract* is het resultaat van het initiatieproces. Het is de schriftelijk vastgelegde overeenkomst met betrekking tot het ontwikkelen van een EDI systeem tussen de betrokken partijen.

Onder *EDI ontwerp omgeving* wordt verstaan die factoren in de omgeving van het ontwerpproces die het ontwerpproces rechtstreeks beïnvloeden.
Het *EDI ontwerpproces* bestaat uit activiteiten die tot doel hebben te komen tot een EDI basisontwerp. De besturing van het ontwerpproces verloopt aan de hand van een aantal centrale factoren.
Het *EDI ontwerp* is het resultaat van het ontwerpproces. Hier onder wordt verstaan het basisontwerp van het EDI systeem. In het basisontwerp wordt vormgegeven aan de kwaliteitsattributen van het EDI systeem.
Onder *EDI ontwerp succes* wordt verstaan de mate waarin de in het samenwerkingscontract gespecificeerde kwaliteit, kosten en levertijdstip van het EDI ontwerp worden gerealiseerd.

Het *EDI implementatieproces* bestaat uit activiteiten die tot doel hebben te komen tot een geïmplementeerd EDI systeem. De besturing van het implementatieproces verloopt aan de hand van een aantal centrale factoren. Deze factoren worden in deze enquête niet meegenomen.
Onder *EDI implementatie succes* wordt verstaan de mate waarin de in het EDI basisontwerp gespecificeerde kwaliteit, kosten en levertijdstip van het te implementeren EDI systeem worden gerealiseerd.

Wij zijn geïnteresseerd in de manier waarop het initiatieproces en het ontwerpproces en de resultaten daarvan in uw project zijn verlopen. Hierover worden een aantal vragen gesteld. De vragen hebben dus geen betrekking op de techniek-kant van EDI, maar op de organisatie-kant van EDI.



De antwoorden dienen aangekruist te worden uit een vijftal mogelijkheden. U kruist dus één van de vijf mogelijkheden aan.

EDI INITIATIEPROCES: CENTRALE FACTOREN

C0 Bent u direct betrokken geweest bij het initiatieproces van het EDI project?

( ) Ja ------> ga door met C1
( ) Nee ------> ga door met E1 en laat een persoon die direct betrokken is geweest bij het initiatieproces de vragen C1 tot en met D5 invullen

C1 Op welke wijze is er in het initiatieproces een strategisch plan voor het EDI project opgesteld?

( ) er is geen strategisch plan opgesteld
( ) er is een strategisch plan opgesteld waarin doelen en middelen zijn beschreven
( ) er is een strategisch plan opgesteld met een uitgebreide externe en interne analyse en een beschrijving van doelen en middelen
( ) er is een strategisch plan opgesteld met een uitgebreide externe en interne analyse en een beschrijving van doelen en middelen sterk afgeleid van de strategische plannen van de betrokken partijen
( ) er is een strategisch plan opgesteld met een uitgebreide externe en interne analyse en een beschrijving van doelen en middelen, dat integraal is opgesteld binnen de strategische planning van de afzonderlijke betrokken partijen.

C2 Op welke wijze zijn de kosten en baten van EDI voor de betrokken partijen in het initiatieproces bepaald?

( ) de kosten en baten van EDI voor de betrokken partijen zijn niet bepaald
( ) de kosten en baten van EDI voor de betrokken partijen zijn globaal bepaald
( ) de kosten en baten van EDI voor de betrokken partijen zijn bepaald per uit te wisselen bericht
( ) de kosten en baten van EDI voor de betrokken partijen zijn bepaald per uit te wisselen bericht. Tevens is er een verrekeningsgrondslag tussen de betrokken partijen opgesteld.
( ) de kosten en baten van EDI voor de betrokken partijen zijn bepaald per uit te wisselen bericht. Tevens is er een verrekeningsgrondslag tussen de betrokken partijen opgesteld binnen het kader van een opgestelde juridische- en financieringsstructuur

C3 Op welke wijze zijn er in het initiatieproces voordelen met betrekking tot EDI voor de betrokken partijen aantoonbaar geworden?

( ) in het initiatieproces bleken geen voordelen voor de betrokken partijen aantoonbaar te kunnen worden gemaakt
( ) in het initiatieproces bleken enkele voordelen voor een enkele betrokken partij aantoonbaar te kunnen worden gemaakt
( ) in het initiatieproces bleken enkele voordelen voor enkele betrokken partijen aantoonbaar te kunnen worden gemaakt
( ) in het initiatieproces bleken veel voordelen voor enkele betrokken partijen aantoonbaar te kunnen worden gemaakt
( ) in het initiatieproces bleken zeer veel voordelen voor alle betrokken partijen aantoonbaar te kunnen worden gemaakt

C4 Op welke wijze is de keuze van de betrokken partijen in het initiatieproces tot stand gekomen?

( ) de betrokken partijen zijn niet gekozen
( ) de betrokken partijen zijn willekeurig gekozen
( ) de betroken partijen zijn gekozen om hun onderlinge bekendheid
( ) de betrokken partijen zijn gekozen om hun onderlinge bekendheid en aan de hand van een opgestelde algemene profielschets
( ) de betrokken partijen zijn gekozen om hun onderlingen bekendheid en aan de hand van een opgestelde gedetailleerde profielschets door middel van het systematisch onderzoeken aan de hand van toetsingscriteria

C5 Op welke wijze heeft de personele invulling van het initiatieproces plaats gevonden?

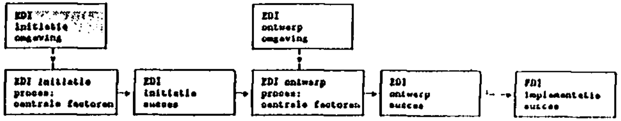
( ) de personele invulling van het initiatieproces is geheel toevallig tot stand gekomen
( ) de personele invulling van het initiatieproces is min of meer toevallig tot stand gekomen
( ) de personele invulling van het initiatieproces is tot stand gekomen door het definiëren van sleutelposities en het invullen van deze posities door de betrokken partijen zonder een daadwerkelijke sturing van de personele invulling
( ) de personele invulling van het initiatieproces is tot stand gekomen door het definiëren van sleutelposities en het invullen van deze posities door de betrokken partijen met een daadwerkelijke sturing van de personele invulling waarbij niet gekeken is naar de potentiële beweging en ontwikkeling van het personeel
( ) de personele invulling van het initiatieproces is tot stand gekomen door het definiëren van sleutelposities en het invullen van deze posities door de betrokken partijen met een daadwerkelijke sturing van de personele invulling waarbij systematisch gekeken is naar de potentiële beweging en ontwikkeling van het personeel

C6 Hoe groot was het onderling vertrouwen tussen de betrokken partijen in het initiatieproces over het EDI project?

( ) er was totaal geen onderling vertrouwen tussen de betrokken partijen
( ) er was een zwak onderling vertrouwen tussen de betrokken partijen
( ) er was een matig onderling vertrouwen tussen de betrokken partijen
( ) er was een sterk onderling vertrouwen tussen de betrokken partijen
( ) er was een volledig onderling vertrouwen tussen de betrokken partijen

C7 Op welke wijze is het initiatieproces gepland?

( ) er was geen planning van het initiatieproces
( ) er was een planning van het initiatieproces als geheel
( ) er was een gedetailleerde planning van elk der activiteiten in het initiatieproces
( ) er was een gedetailleerde planning van elk der activiteiten in het initiatieproces waarbij de planning gerelateerd werd aan een opgesteld kwaliteitsplan
( ) er was een gedetailleerde planning van elk der activiteiten in het initiatieproces waarbij de planning gerelateerd werd aan een opgesteld kwaliteitsplan en aan de systematische verbetering van de productiviteit



EDI INITIATIE OMGEVING

D1 Hoe groot was de concurrentie tussen de organisaties in de sector waar het EDI project betrekking op heeft tijdens het initiatieproces?

( ) er was geen enkele concurrentie tussen de organisaties in de desbetreffende sector
( ) er was een lichte concurrentie tussen de organisaties in de desbetreffende sector
( ) er was een matige concurrentie tussen de organisaties in de desbetreffende sector
( ) er was een sterke concurrentie tussen de organisaties in de desbetreffende sector
( ) er was een zeer sterke concurrentie tussen de organisaties in de desbetreffende sector

D2 In welke fase van de groeicyclus zaten de organisaties in de sector waar het EDI project betrekking op heeft tijdens het initiatieproces?

( ) de sector zat in de innovatiefase van de groeicyclus
( ) de sector zat in de expansiefase van de groeicyclus
( ) de sector zat in de rijpheidsfase van de groeicyclus
( ) de sector zat in de stagnatiefase van de groeicyclus
( ) de sector zat in de teruggangsfase van de groeicyclus

D3 In welke fase van de produkt/markt levenscyclus bevonden de produkt/markt combinaties zich waar het EDI project betrekking op heeft tijdens het initiatieproces?

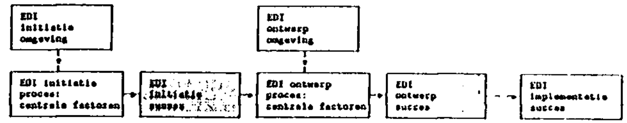
( ) de produkt/markt combinatie bevindt zich in de ontwikkelingsfase
( ) de produkt/markt combinatie bevindt zich in de adoptiefase
( ) de produkt/markt combinatie bevindt zich in de diffusiefase
( ) de produkt/markt combinatie bevindt zich in de verzadigingsfase
( ) de produkt/markt combinatie bevindt zich in de terugnamefase

D4 Op welke wijze was de machtsverdeling tussen partijen in de sector tijdens het initatieproces te karakteriseren?

( ) zeer veel partijen hebben een dominante macht over de andere partijen in de sector
( ) veel partijen hebben een dominante macht over de andere partijen in de sector
( ) enkele partijen hebben een dominante macht over de andere partijen in de sector
( ) één partij heeft een dominante macht over de andere partijen in de sector
( ) geen van de partijen heeft een dominante macht over de andere partijen in de sector

D5 Op welke wijze was de organisatiegraad (branche-organisatie, EDI-organisatie) in de sector tijdens het initiatieproces te karakteriseren?

( ) er was geen branch-organisatie of EDI-organisatie in de sector aanwezig
( ) er was een branch-organisatie of EDI-organisatie in de sector, echter deze is niet betrokken geweest bij het initiatieproces van het EDI project
( ) er was een branch-organisatie of EDI-organisatie in de sector, deze is betrokken geweest bij het initiatieproces van het EDI project
( ) er was een EDI-organisatie in de sector die sterk betrokken is geweest bij het initiatieproces van het EDI project
( ) er zijn verschillende EDI-organisaties die sterk betrokken zijn geweest bij het initiatieproces van het EDI project



De antwoorden dienen aangekruist te worden uit een of meerdere mogelijkheden.
U kruist dus één of meerdere mogelijkheden aan.

EDI INITIATIE SUCCES

E1 Is het initiatieproces afgesloten met een samenwerkingscontract met betrekking tot EDI tussen de partijen (het samenwerkingscontract kan ook een onderdeel uitmaken van een algemeen samenwerkingscontract tussen bijvoorbeeld toeleveranciers en afnemers)?

( ) Ja ———> ga door met E2
( ) Nee ———> ga door met G1

E2 Wanneer werd het samenwerkingscontract gesloten tussen de partijen in het EDI project?

.... (dag-maand-jaar)

E3 Kunt u aangeven welke van de volgende doelen in het samenwerkingscontract werden gespecificeerd?

( ) Het versnellen van de berichtenuitwisseling tussen de partijen
( ) Het standaardiseren van berichten tussen de partijen
( ) Het verlagen van de transactiekosten tussen de partijen
( ) Het verminderen van invoerfouten ten behoeve van de berichtenuitwisseling
( ) Het verhogen van de gebruikersvriendelijkheid van de berichtenuitwisseling
( ) Het verhogen van de verwerkingscapaciteit van de berichtenuitwisseling
( ) Het koppelen van interne informatiesystemen met het EDI systeem
( ) Er werden geen of geen van deze doelen in het samenwerkingscontract gespecificeerd

E4 Wordt er in het samenwerkingscontract tussen partijen aandacht besteed aan de volgende elementen:

wijze van besluitvorming	[ ] Ja	[ ] Nee
mededelingsregelingen	[ ] Ja	[ ] Nee
rechten van industriële eigendom	[ ] Ja	[ ] Nee
interne verrekenprijzen	[ ] Ja	[ ] Nee
winstvaststelling	[ ] Ja	[ ] Nee
winstbestemming	[ ] Ja	[ ] Nee
kwaliteit van te ontwerpen EDI systeem	[ ] Ja	[ ] Nee
kosten van te ontwerpen EDI systeem	[ ] Ja	[ ] Nee
levertijd van te ontwerpen EDI systeem	[ ] Ja	[ ] Nee
kosten van te implementeren EDI systeem	[ ] Ja	[ ] Nee
levertijd van implementeren EDI systeem	[ ] Ja	[ ] Nee
acceptatie criteria	[ ] Ja	[ ] Nee
acceptatie procedures	[ ] Ja	[ ] Nee
af te leveren rapporten, specificaties of andere documenten	[ ] Ja	[ ] Nee
verantwoordelijkheden van de gecontracteerden	[ ] Ja	[ ] Nee
verantwoordelijkheden van de opdrachtgever	[ ] Ja	[ ] Nee
aansprakelijkheid van de gecontracteerden ten aanzien van kwaliteit van het op te leveren produkt, kosten, aflevertijdstip	[ ] Ja	[ ] Nee
boetes gerelateerd aan product kwaliteit	[ ] Ja	[ ] Nee
boetes gerelateerd aan kostenoverschrijding	[ ] Ja	[ ] Nee
boetes gerelateerd aan levertijdoverschrijding	[ ] Ja	[ ] Nee

EDI ONTWERP

F1 Wordt er in het samenwerkingscontract aandacht besteed aan het EDI ontwerp?

( ) Ja ------> ga door met F2
( ) Nee ------> ga door met G2

F2 Is de te realiseren kwaliteit van het EDI ontwerp in het samenwerkingscontract gespecificeerd?

( ) Ja ------> ga door met F3
( ) Nee ------> ga door met F5

F3 Welke dynamische kwaliteitsattributen van het EDI ontwerp zijn in het samenwerkingscontract gespecificeerd?

betrouwbaarheid		
juistheid van de berichtenverwerking	[ ] Ja	[ ] Nee
volledigheid van de berichtenverwerking	[ ] Ja	[ ] Nee
geoorloofdheid van de berichtenverwerking	[ ] Ja	[ ] Nee
tijdigheid van de berichten	[ ] Ja	[ ] Nee
continuïteit		
bedrijfszekerheid van het EDI systeem	[ ] Ja	[ ] Nee
veerkracht van het EDI systeem	[ ] Ja	[ ] Nee
herstelbaarheid van het EDI systeem	[ ] Ja	[ ] Nee
degradatiemogelijkheden van het EDI systeem	[ ] Ja	[ ] Nee
uitwijkmogelijkheden van het EDI systeem	[ ] Ja	[ ] Nee
efficiëntie		
snelheid van het EDI systeem	[ ] Ja	[ ] Nee
gebruiksvriendelijkheid van het EDI systeem	[ ] Ja	[ ] Nee
zuinigheid van het EDI systeem	[ ] Ja	[ ] Nee
aansluiting op handmatige procedures	[ ] Ja	[ ] Nee
werkbaarheid van handmatige procedures	[ ] Ja	[ ] Nee
effectiviteit		
dekkingsgraad over bedrijfsfuncties	[ ] Ja	[ ] Nee
beschikbaarheid van het EDI systeem	[ ] Ja	[ ] Nee
bruikbaarheid van het EDI systeem	[ ] Ja	[ ] Nee
ondersteuning voor besluitvorming	[ ] Ja	[ ] Nee
ondersteuning van eindgebruiker	[ ] Ja	[ ] Nee

F4 Welke statische kwaliteitsattributen van het EDI ontwerp zijn in het samenwerkingscontract gespecificeerd?

flexibiliteit	[ ] Ja	[ ] Nee
onderhoudbaarheid	[ ] Ja	[ ] Nee
testbaarheid	[ ] Ja	[ ] Nee
portabiliteit	[ ] Ja	[ ] Nee
interne connectiviteit	[ ] Ja	[ ] Nee
externe connectiviteit	[ ] Ja	[ ] Nee
herbruikbaarheid	[ ] Ja	[ ] Nee
geschiktheid infrastructuur	[ ] Ja	[ ] Nee

F5 Zijn de te verwachten kosten van het EDI ontwerp in het samenwerkingscontract gespecificeerd?

( ) Ja ------> ga door met F6
( ) Nee ------> ga door met F7

F6 Kunt u de geplande totale kosten (budget) van het EDI ontwerp aangeven door één van de hokjes aan te kruisen?

[ ]	0 - 50.000	[ ]	500.000 - 550.000	[ ]	Meer dan 1.000.000
[ ]	50.000 - 100.000	[ ]	550.000 - 600 000		
[ ]	100.000 - 150.000	[ ]	600.000 - 650.000		
[ ]	150.000 - 200.000	[ ]	650.000 - 700.000		
[ ]	200.000 - 250.000	[ ]	700.000 - 750.000		
[ ]	250.000 - 300.000	[ ]	750.000 - 800.000		
[ ]	300.000 - 350.000	[ ]	800.000 - 850.000		
[ ]	350.000 - 400.000	[ ]	850.000 - 900.000		
[ ]	400.000 - 450.000	[ ]	900.000 - 950.000		
[ ]	450.000 - 500.000	[ ]	950.000 - 1000.000		

F7 Is het levertijdstip van het EDI ontwerp in het samenwerkingscontract gespecificeerd?

( ) Ja ------> ga door met F8
( ) Nee ------> ga door met H1

F8 Wat is het geplande levertijdstip van het EDI ontwerp?

.... (dag-maand-jaar)

------> ga door met H1

G1 Waarom is er geen samenwerkingscontract met betrekking tot EDI tussen de partijen (handelspartners) afgesloten?

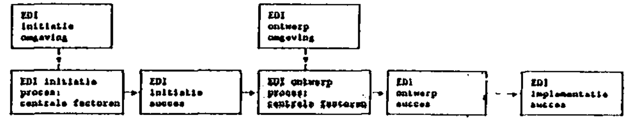
Oorzaak 1: ....
....
Oorzaak 2: ....
....

------> ga door met H1

G2 Waarom is er in het samenwerkingscontract geen aandacht besteed aan het EDI ontwerp?

Oorzaak 1: ....
....
Oorzaak 2: ....
....

------> ga door met H1



Het doorlezen van de nu volgende tekst maakt het mogelijk de volgende vragen snel in te vullen.

Onder ***EDI ontwerp omgeving*** wordt verstaan die factoren in de omgeving van het ontwerpproces die het ontwerpproces rechtstreeks beïnvloeden.
Het ***EDI ontwerpproces*** bestaat uit activiteiten die tot doel hebben te komen tot een EDI basisontwerp. De besturing van het ontwerpproces verloopt aan de hand van een aantal centrale factoren.
Het ***EDI ontwerp*** is het resultaat van het ontwerpproces. Hieronder wordt verstaan het basisontwerp van het EDI systeem. In het basisontwerp wordt vormgegeven aan de kwaliteitsattributen van het EDI systeem.
Onder ***EDI ontwerp succes*** wordt verstaan de mate waarin de in het samenwerkingscontract gespecificeerde kwaliteit, kosten en levertijd van het EDI ontwerp worden gerealiseerd.

De antwoorden dienen aangekruist te worden uit een vijftal mogelijkheden. U kruist dus één van de vijf mogelijkheden aan.

EDI ONTWERPPROCES : CENTRALE FACTOREN

H1 Op welke wijze werden er beleidsuitgangspunten in het ontwerpproces gehanteerd?

( ) er werden geen beleidsuitgangspunten gehanteerd
( ) het top management heeft een beleidsuitgangspunt geformuleerd ten aanzien van verplichtingen voor het projectmanagement
( ) het top management heeft een beleidsuitgangspunt geformuleerd ten aanzien van verplichtingen voor het projectmanagement en het gebruik van een standaard ontwikkelingsproces
( ) het top management heeft een beleidsuitgangspunt geformuleerd ten aanzien van verplichtingen voor het projectmanagement, het gebruik van een standaard ontwikkelingsproces en dat elke nieuwe of verbeterde product versie van een product in het project meetbaar beter is dan zijn voorganger
( ) het top management heeft een beleidsuitgangspunt geformuleerd ten aanzien van verplichtingen voor het projectmanagement, het gebruik van een standaard ontwikkelingsproces en dat elke nieuwe of verbeterde product versie van een product in het project meetbaar beter is dan zijn voorganger. Tevens zijn er beleidsuitgangspunten geformuleerd ten aanzien van productiviteits verbeteringen voor elk der groepen in het project, het gebruik van geïntroduceerde methoden en hulpmiddelen, en het gebruiken van herbruikbare componenten in het ontwerp

H2 Op welke wijze heeft het topmanagement van de betrokken partijen inzicht in het ontwerpproces gekregen?

( ) het topmanagement heeft geen inzicht in het ontwerpproces gekregen
( ) het topmanagement heeft inzicht in het ontwerpproces gekregen doordat er geen verplichtingen werden aangegaan zonder goedkeuring van het topmanagement. Kwaliteitscontrole informeerde het topmanagement over de vooruitgang indien deze niet volgens plan verliep
( ) het topmanagement heeft inzicht in het ontwerpproces gekregen doordat er geen verplichtingen werden aangegaan zonder goedkeuring van het topmanagement. Kwaliteitscontrole informeerde het topmanagement over de vooruitgang indien deze niet volgens plan verliep. Periodieke management reviews werden gehouden over training, technology gebruik, status van het project en project verbeteringsplannen.
( ) het topmanagement heeft inzicht in het ontwerpproces gekregen doordat er geen verplichtingen werden aangegaan zonder goedkeuring van het topmanagement. Kwaliteitscontrole informeerde het topmanagement over de vooruitgang indien deze niet volgens plan verliep. Periodieke management reviews werden gehouden over training, technology gebruik, status van het project en project verbeteringsplannen en over de resultaten versus kwaliteitsplannen en kwaliteits verbeterings acties
( ) het topmanagement heeft inzicht in het ontwerpproces gekregen doordat er geen verplichtingen werden aangegaan zonder goedkeuring van het topmanagement. Kwaliteitscontrole informeerde het topmanagement over de vooruitgang indien deze niet volgens plan verliep. Periodieke management reviews werden gehouden over training, technology gebruik, status van het project en project verbeteringsplannen en over de resultaten versus kwaliteitsplannen en kwaliteits verbeterings acties en over de resultaten versus productiviteitsplannen

H3 Op welke wijze speelden de middelen, bijvoorbeeld de personele middelen, een rol in het ontwerpproces?

( ) middelen speelden geen rol in het ontwerpproces
( ) vanuit kwaliteitseisen van het eindprodukt worden voldoende middelen toegekend
( ) vanuit kwaliteitseisen van het eindprodukt worden voldoende middelen toegekend. Een software engineering proces groep is ingesteld om het proces van verbeterings activiteiten te leiden en om het bewustzijn van effectieve management methoden te verzekeren.
( ) vanuit kwaliteitseisen van het eindprodukt worden voldoende middelen toegekend. Een software engineering proces groep is ingesteld om het proces van verbeterings activiteiten te leiden en om het bewustzijn van effectieve management methoden te verzekeren. Er worden middelen beschikbaar gesteld om ontwerptechnologie in het ontwerpproces op te nemen
( ) vanuit kwaliteitseisen van het eindprodukt worden voldoende middelen toegekend. Een software engineering proces groep is ingesteld om het proces van verbeterings activiteiten te leiden en om het bewustzijn van effectieve management methoden te verzekeren. Er worden middelen beschikbaar gesteld om ontwerptechnologie in het ontwerpproces op te nemen en om hergebruik van de ontwerpcomponenten te verkrijgen, ontwikkelen, introduceren of bij te staan.

H4 Op welke wijze waren er tijdens het ontwerpproces beperkingen ten aanzien van de personele middelen?

( ) er waren voortdurend en onverwacht beperkingen ten aanzien van de personele middelen tijdens het ontwerpproces
( ) er waren af ten toe en veelal onverwachte beperkingen ten aanzien van de personele middelen tijdens het ontwerpproces
( ) beperkingen ten aanzien van de personele middelen tijdens het ontwerpproces werden systematisch voorzien en geanalyseerd. Activiteiten werden ontplooid om deze beperkingen te verminderen.
( ) beperkingen ten aanzien van de personele middelen tijdens het ontwerpproces werden systematisch voorzien en geanalyseerd. Activiteiten werden ontplooid om deze beperkingen te verminderen. Beperkingen ten aanzien van personele middelen voor het introduceren van ontwerptechnologie werden systematisch gepland
( ) beperkingen ten aanzien van de personele middelen tijdens het ontwerpproces werden systematisch voorzien en geanalyseerd. Activiteiten werden ontplooid om deze beperkingen te verminderen. Beperkingen ten aanzien van personele middelen voor het introduceren van ontwerptechnologie werden systematisch gepland en er werd aandacht besteed aan beperkingen ten aanzien van personele middelen voor het het hergebruik van onderdelen van het ontwerp

H5 Welk ervaringsnivo was er tijdens het ontwerpproces met betrekking tot EDI aanwezig?

( ) het ervaringsnivo tijdens het ontwerpproces met betrekking tot EDI was zeer laag
( ) het ervaringsnivo tijdens het ontwerpproces met betrekking tot EDI was laag
( ) het ervaringsnivo tijdens het ontwerpproces met betrekking tot EDI was matig
( ) het ervaringsnivo tijdens het ontwerpproces met betrekking tot EDI was hoog
( ) het ervaringsnivo tijdens het ontwerpproces met betrekking tot EDI was zeer hoog

H6 Op welke wijze werden de betrokken partijen in het ontwerpproces vertegenwoordigd?

( ) in het ontwerpproces werden de betrokken partijen door de afgevaardigde ontwerpers zeer slecht vertegenwoordigd
( ) in het ontwerpproces werden de betrokken partijen door de afgevaardigde ontwerpers slecht vertegenwoordigd
( ) in het ontwerpproces werden de betrokken partijen door de afgevaardigde ontwerpers matig vertegenwoordigd
( ) in het ontwerpproces werden de betrokken partijen door de afgevaardigde ontwerpers goed vertegenwoordigd
( ) in het ontwerpproces werden de betrokken partijen door de afgevaardigde ontwerpers zeer goed vertegenwoordigd

H7 Op welke wijze vond de communicatie tussen ontwerpers en eindgebruikers in het ontwerpproces plaats?

( ) er was geen aandacht voor de communicatie in het ontwerpproces
( ) er vond communicatie plaats om de ontwerpers duidelijk te maken wat de eisen aan het EDI ontwerp zijn
( ) er vond communicatie plaats om de ontwerpers duidelijk te maken wat de eisen aan het EDI ontwerp zijn. Er vond communicatie plaats om technische en functionele eisen van het EDI ontwerp aan elkaar te relateren.
( ) er vond communicatie plaats om de ontwerpers duidelijk te maken wat de eisen aan het EDI ontwerp zijn. Er vond communicatie plaats om technische en functionele eisen van het EDI ontwerp aan elkaar te relateren. Er vond communicatie plaats over het ontwerpproces en de benodigde hulpmiddelen en methoden.
( ) er vond communicatie plaats om de ontwerpers duidelijk te maken wat de eisen aan het EDI ontwerp zijn. Er vond communicatie plaats om technische en functionele eisen van het EDI ontwerp aan elkaar te relateren. Er vond communicatie plaats over het ontwerpproces en de benodigde hulpmiddelen en methoden en het ontwerpproces en over objectieve evaluatie en herziening van de benodigde hulpmiddelen en methoden

H8 Op welke wijze vinden trainingen tijdens het ontwerpproces plaats?

( ) er vinden geen trainingen plaats.
( ) er is een trainings programma opgezet. Standaard trainingen worden aangeboden op het gebied van schatten, het onderhandelingsproces en management verandering.
( ) er is een trainings programma opgezet. Standaard trainingen worden aangeboden op het gebied van schatten, het onderhandelingsproces en management verandering en op het gebied van kwaliteitsmanagement. Een trainingsplan is ontwikkeld dat de vereiste trainingen voor iedere functie definieert.
( ) er is een trainings programma opgezet. Standaard trainingen worden aangeboden op het gebied van schatten, het onderhandelingsproces en management verandering en op het gebied van kwaliteitsmanagement. Een trainingsplan is ontwikkeld dat de vereiste trainingen voor iedere functie definieert. Trainingen worden aangeboden op het gebied van geavanceerde ontwikkelingsmethoden.
( ) er is een trainings programma opgezet. Standaard trainingen worden aangeboden op het gebied van schatten, het onderhandelingsproces en management verandering en op het gebied van kwaliteitsmanagement. Een trainingsplan is ontwikkeld dat de vereiste trainingen voor iedere functie definieert. Trainingen worden aangeboden op het gebied van geavanceerde ontwikkelingsmethoden en op het gebied van hergebruik methoden.

H9 Op welke wijze is het ontwerpproces gepland?

( ) er was geen planning van het ontwerpproces
( ) er was een planning van het ontwerpproces als geheel
( ) er was een gedetailleerde planning van elk der activiteiten in het ontwerpproces
( ) er was een gedetailleerde planning van elk der activiteiten in het ontwerpproces en een kwaliteitsplan van het ontwerpproces
( ) er was een gedetailleerde planning van elk der activiteiten in het ontwerpproces, een kwaliteitsplan van het ontwerpproces en een ontwerpproces verbeteringsplan met productiviteits verbeteringsacties

H10 Op welke wijze is het ontwerpproces gevolgd en bewaakt?

( ) het ontwerpproces is niet gevolgd en bewaakt
( ) het ontwerpproces is gevolgd en bewaakt aan de hand van standaarden en procedures
( ) het ontwerpproces is gevolgd en bewaakt aan de hand van standaarden en procedures per deelactiviteit in het gedefinieerde proces. Er hebben ontwerp inspecties plaats gevonden.
( ) het ontwerpproces is gevolgd en bewaakt aan de hand van standaarden en procedures per deelactiviteit in het gedefinieerde proces. Er hebben ontwerp inspecties plaats gevonden. De vervulling van het ontwerpproces is gevolgd en bewaakt met behulp van kwaliteitsplannen.
( ) het ontwerpproces is gevolgd en bewaakt aan de hand van standaarden en procedures per deelactiviteit in het gedefinieerde proces. Er hebben ontwerp inspecties plaats gevonden. De vervulling van het ontwerpproces is gevolgd en bewaakt met behulp van kwaliteitsplannen en met behulp van procesverbetering- en productiviteitsplannen

H11 Op welke wijze is het project gedurende het ontwerpproces beheerst?

( ) het project is tijdens het ontwerpproces niet beheerst
( ) het project is tijdens het ontwerpproces beheerst door beheersing van veranderingen van ontwerpeisen. Versie beheer maakt daarvan een onderdeel uit.
( ) het project is tijdens het ontwerpproces beheerst door beheersing van veranderingen van ontwerpeisen. Versie beheer maakt daarvan een onderdeel uit. Ontwikkelingsmethoden en -hulpmiddelen worden beheerd door configuratie management.
( ) het project is tijdens het ontwerpproces beheerst door beheersing van veranderingen van ontwerpeisen. Versie beheer maakt daarvan een onderdeel uit. Ontwikkelingsmethoden en -hulpmiddelen worden beheerd door configuratie management. Configuratie management beheert ook het kwaliteitsplan.
( ) het project is tijdens het ontwerpproces beheerst door beheersing van veranderingen van ontwerpeisen. Versie beheer maakt daarvan een onderdeel uit. Ontwikkelingsmethoden en -hulpmiddelen worden beheerd door configuratie management. Configuratie management beheert ook het kwaliteitsplan. Het ontwerpproces is verder beheerst door herbruikbare componenten in het ontwerpproces en hun definities te beheersen.

H12 Op welke wijze is in het ontwerpproces de relatie met eventuele software leverancier(s) vastgelegd?

( ) deze relatie is geheel niet vastgelegd
( ) verantwoordelijkheden en middelen worden vastgelegd om de leveranciers performance te vergelijken met die zoals in het plan vastgelegd.
( ) verantwoordelijkheden en middelen worden vastgelegd om de leveranciers performance te vergelijken met die zoals in het plan vastgelegd. Formele procedures worden ingesteld om de leveranciers te selecteren. Software kwaliteitsverzekering wordt gebruikt om de leveranciers' performance te tonen.
( ) verantwoordelijkheden en middelen worden vastgelegd om de leveranciers performance te vergelijken met die zoals in het plan vastgelegd. Formele procedures worden ingesteld om de leveranciers te selecteren. Software kwaliteitsverzekering wordt gebruikt om de leveranciers' performance te tonen. Middelen worden ingezet voor de koppeling met de leveranciers' ontwikkel omgeving.
( ) verantwoordelijkheden en middelen worden vastgelegd om de leveranciers performance te vergelijken met die zoals in het plan vastgelegd. Formele procedures worden ingesteld om de leveranciers te selecteren. Software kwaliteitsverzekering wordt gebruikt om de leveranciers' performance te tonen en te verbeteren. Middelen worden ingezet voor de koppeling met de leveranciers' ontwikkel omgeving en de verbetering van de leveranciersproduktiviteit.

H13 Op welke wijze bestond er tijdens het ontwerpproces afstemming tussen de besluitvorming in het project en de besluitvorming in de participerende organisaties?

( ) er bestond tijdens het ontwerpproces totaal geen afstemming tussen de besluitvorming in het project en de besluitvorming in de participerende organisaties
( ) er bestond tijdens het ontwerpproces vrijwel geen afstemming tussen de besluitvorming in het project en de besluitvorming in de participerende organisaties
( ) er bestond tijdens het ontwerpproces matig afstemming tussen de besluitvorming in het project en de besluitvorming in de participerende organisaties
( ) er bestond tijdens het ontwerpproces veel afstemming tussen de besluitvorming in het project en de besluitvorming in de participerende organisaties
( ) er bestond tijdens het ontwerpproces zeer veel afstemming tussen de besluitvorming in het project en de besluitvorming in de participerende organisaties

H14 Op welke wijze is het ontwerpproces gedefinieerd?

( ) het ontwerpproces is niet gedefinieerd
( ) het ontwerpproces is gedefinieerd met behulp van gedocumenteerde standaarden met betrekking tot benodigde capaciteiten, doorlooptijden en productplannen
( ) het ontwerpproces is gedefinieerd met behulp van gedocumenteerde standaarden met betrekking tot benodigde capaciteiten, doorlooptijden en productplannen en produkt kwaliteitsrapporten. Voor ontwerp activiteiten en het verbeteren van produkt en ontwerp standaarden zijn er handboeken gedefinieerd
( ) het ontwerpproces is gedefinieerd met behulp van gedocumenteerde standaarden met betrekking tot benodigde capaciteiten, doorlooptijden en productplannen en produkt kwaliteitsrapporten. Voor ontwerp activiteiten en het verbeteren van produkt en ontwerp standaarden zijn er handboeken gedefinieerd. Het ontwerpproces is gedefinieerd met behulp van kwaliteitsplannen voor elke ontwerpproces taak
( ) het ontwerpproces is gedefinieerd met behulp van gedocumenteerde standaarden met betrekking tot benodigde capaciteiten, doorlooptijden en productplannen en produkt kwaliteitsrapporten. Voor ontwerp activiteiten en het verbeteren van produkt en ontwerp standaarden zijn er handboeken gedefinieerd. Het ontwerpproces is gedefinieerd met behulp van kwaliteitsplannen voor elke ontwerpproces taak. Gedocumenteerde richtlijnen en standaards zijn opgesteld voor hergebruik van ontwerpcomponenten.

H15 Op welke wijze is het ontwerpproces uitgevoerd?

( ) het ontwerpproces is willekeurig uitgevoerd
( ) het ontwerpproces is uitgevoerd met behulp van een of meerdere ontwerpmethoden en projectplanningsmethoden.
( ) het ontwerpproces is uitgevoerd met behulp van een of meerdere ontwerpmethoden en projectplanningsmethoden. Gedocumenteerde methoden zijn gebruikt voor het ontwerp, bouw, inspectie en testen.
( ) het ontwerpproces is uitgevoerd met behulp van een of meerdere ontwerpmethoden en projectplanningsmethoden. Gedocumenteerde methoden zijn gebruikt voor het ontwerp, bouw, inspectie en testen. Prototyping maakt hiervan een belangrijk onderdeel uit.
( ) het ontwerpproces is uitgevoerd met behulp van een of meerdere ontwerpmethoden en projectplanningsmethoden. Gedocumenteerde methoden zijn gebruikt voor het ontwerp, bouw, inspectie en testen. Prototyping en hergebruik van onderdelen van het ontwerp maken hiervan een belangrijk onderdeel uit.

H16 Op welke wijze is het ontwerpproces geanalyseerd?

( ) het ontwerpproces is niet geanalyseerd
( ) het ontwerpproces is geanalyseerd door middel van metingen en analyses zijn gemaakt van het verbruikte personeel, grootte van de kengetallen en verbruikte middelen versus die in het plan gespecificeerd zijn.
( ) het ontwerpproces is geanalyseerd door middel van metingen en analyses zijn gemaakt van het verbruikte personeel, grootte van de kengetallen en verbruikte middelen versus die in het plan gespecificeerd zijn en van gevonden fouten en opgelopen kosten tijdens proces activiteiten
( ) het ontwerpproces is geanalyseerd door middel van metingen en analyses zijn gemaakt van het verbruikte personeel, grootte van de kengetallen en verbruikte middelen versus die in het plan gespecificeerd zijn en van gevonden fouten en opgelopen kosten tijdens proces activiteiten. Een proces database en een kwaliteit rapportage systeem zijn opgesteld
( ) het ontwerpproces is geanalyseerd door middel van metingen en analyses zijn gemaakt van het verbruikte personeel, grootte van de kengetallen en verbruikte middelen versus die in het plan gespecificeerd zijn en van gevonden fouten en opgelopen kosten tijdens proces activiteiten. Een proces database en een kwaliteit rapportage systeem zijn opgesteld. Metingen en analyses zijn gemaakt van het hergebruik van ontwerpcomponenten.

H17 Op welke wijze is het ontwerpproces beheerst?

( ) het ontwerpproces is niet beheerst
( ) het ontwerpproces is beheerst door het vastleggen van procedures en verantwoordelijkheden
( ) het ontwerpproces is beheerst door het vastleggen van procedures en verantwoordelijkheden ten aanzien van ontwerpeisen, ontwerpproces standaards, kostenbeheersing, validatie van het ontwerp.
( ) het ontwerpproces is beheerst door het vastleggen van procedures en verantwoordelijkheden ten aanzien van ontwerpeisen, ontwerpproces standaards, kostenbeheersing, validatie van het ontwerp. Tevens zijn procedures en verantwoordelijkheden in relatie tot het kwaliteitsplan vastgelegd en ten aanzien van de introductie van nieuwe ontwerphulpmiddelen.
( ) het ontwerpproces is beheerst door het vastleggen van procedures en verantwoordelijkheden ten aanzien van ontwerpeisen, ontwerpproces standaards, kostenbeheersing, validatie van het ontwerp. Tevens zijn procedures en verantwoordelijkheden in relatie tot het kwaliteitsplan vastgelegd en ten aanzien van de introductie van nieuwe ontwerphulpmiddelen. Tevens zijn procedures en verantwoordelijkheden vastgelegd ten aanzien van productiviteits beheersing en het hergebruik van onderdelen van het ontwerp.

H18 Op welke wijze wordt ontwerptechnologie (zoals CASE-tools, workbenches e.d.) in het ontwerpproces opgenomen?

( ) de ontwerptechnologie wordt in het ontwerpproces niet opgenomen
( ) er worden middelen ingezet om beschikbare hulpmiddelen en methoden te gaan gebruiken
( ) er worden middelen ingezet om beschikbare hulpmiddelen en methoden te gaan gebruiken. Een ontwerptechnologie opname plan is opgezet
( ) er worden middelen ingezet om beschikbare hulpmiddelen en methoden te gaan gebruiken. Een ontwerptechnologie opname plan is opgezet. Faciliteiten ter ondersteuning van de ontwerptechnologie zijn ingevoerd.
( ) er worden middelen ingezet om beschikbare hulpmiddelen en methoden te gaan gebruiken. Een ontwerptechnologie opname plan is opgezet. Faciliteiten ter ondersteuning van de ontwerptechnologie zijn ingevoerd. Prototyping van potentiele hulpmiddelen en methoden wordt uitgevoerd.

H19 Op welke wijze is een ontwerptechnologische omgeving voor het ontwerpproces vormgegeven?

( ) er is geen ontwerptechnologische omgeving vormgegeven
( ) er is nagedacht over de vormgeving van een ontwerptechnologische omgeving
( ) een technologie omgeving is verkregen en geïnstalleerd
( ) een technologie omgeving is verkregen en geïnstalleerd en zo geïnstrumenteerd dat deze proces data levert
( ) een technologie omgeving is verkregen en geïnstalleerd en zo geïnstrumenteerd dat deze proces data levert. De nieuwste methoden en technieken worden in deze technologie omgeving ingebouwd.

H20 Op welke wijze vond het ontwerp van de technische architectuur (hardware, communicatiefaciliteiten) plaats?

( ) er was geen aandacht voor het ontwerpen van de technische architectuur
( ) er was geringe aandacht voor het ontwerpen van de technische architectuur
( ) er was matige aandacht voor het ontwerpen van de technische architectuur
( ) er was veel aandacht voor het ontwerpen van de technische architectuur
( ) er was zeer veel aandacht voor het ontwerpen van de technische architectuur

H21 Op welke wijze vond het modelleren van de gegevens in de berichten plaats?

( ) er was geen aandacht voor het modelleren van de gegevens
( ) er was geringe aandacht voor het modelleren van de gegevens
( ) er was matige aandacht voor het modelleren van de gegevens
( ) er was veel aandacht voor het modelleren van de gegevens
( ) er was zeer veel aandacht voor het modelleren van de gegevens

H22 Op welke wijze werd er gebruik gemaakt van gestandaardiseerde berichten bijv. EDIFACT?

( ) er werd geen gebruik gemaakt van gestandaardiseerde berichten
( ) er werd gering gebruik gemaakt van gestandaardiseerde berichten
( ) er werd matig gebruik gemaakt van gestandaardiseerde berichten
( ) er werd veel gebruik gemaakt van gestandaardiseerde berichten
( ) er werd zeer veel gebruik gemaakt van gestandaardiseerde berichten

H23 Op welke wijze werd er gebruik gemaakt van standaard EDI software?

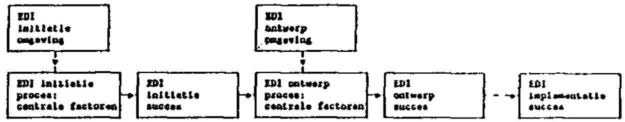
( ) er werd geen gebruik gemaakt van standaard EDI software
( ) er werd gering gebruik gemaakt van standaard EDI software
( ) er werd matig gebruik gemaakt van standaard EDI software
( ) er werd veel gebruik gemaakt van standaard EDI software
( ) er werd zeer veel gebruik gemaakt van standaard EDI software

H24 Op welke wijze was er sprake van gebruikersbetrokkenheid in het ontwerpproces?

( ) er was geen gebruikersbetrokkenheid in het ontwerpproces
( ) er was geringe gebruikersbetrokkenheid in het ontwerpproces
( ) er was matige gebruikersbetrokkenheid in het ontwerpproces
( ) er was veel gebruikersbetrokkenheid in het ontwerpproces
( ) er was zeer veel gebruikersbetrokkenheid in het ontwerpproces

H25 Op welke wijze werd er aandacht gegeven aan het organisatieontwerp binnen het EDI ontwerp?

( ) er werd geen aandacht besteed aan het organisatieontwerp binnen het EDI ontwerp
( ) er werd geringe aandacht besteed aan het organisatieontwerp binnen het EDI ontwerp
( ) er werd matige aandacht besteed aan het organisatieontwerp binnen het EDI ontwerp
( ) er werd veel aandacht besteed aan het organisatieontwerp binnen het EDI ontwerp
( ) er werd zeer veel aandacht besteed aan het organisatieontwerp binnen het EDI ontwerp



EDI ONTWERP OMGEVING

I1 Op welke wijze is de automatiseringgraad van de betrokken organisaties, aan de hand van de zogenaamde Nolan-fasen, tijdens het ontwerpproces te karakteriseren?

( ) de betrokken organisaties bevinden zich in de pioniersfase met betrekking tot automatisering. Een kenmerk van deze fase is dat automatisering een onderdeel is van de administratie.
( ) de betrokken organisaties bevinden zich in de uitgroeifase met betrekking tot automatisering. Een kenmerk van deze fase is dat automatisering door een zelfstandige (automatiserings) afdeling wordt ondersteund.
( ) de betrokken organisaties bevinden zich in de bestendigingsfase met betrekking tot automatisering. Een kenmerk van deze fase is dat automatisering verantwoord wordt tegenover opdrachtgevers.
( ) de betrokken organisaties bevinden zich in de integratiefase met betrekking tot automatisering. Een kenmerk van deze fase is dat er kostendoorberekening en projectmanagement plaats vindt met betrekking tot automatisering.
( ) de betrokken organisaties bevinden zich in de informatiebeheerfase met betrekking tot automatisering. Een kenmerk van deze fase is dat er automatisering plaats vindt expliciet met het oog op bedrijfsdoelstellingen.
( ) de betrokken organisaties bevinden zich in de rijpheidfase met betrekking tot automatisering. Een kenmerk van deze fase is dat de relatie gebruiker - informaticus expliciet centraal staat met betrekking tot automatisering.

I2 Op welke wijze is het verschil in automatiseringsgraad tussen de betrokken organisaties tijdens het ontwerpproces te karakteriseren?

( ) het verschil in automatiseringsgraad tussen de betrokken organisaties is zeer groot
( ) het verschil in automatiseringsgraad tussen de betrokken organisaties is groot
( ) het verschil in automatiseringsgraad tussen de betrokken organisaties is matig
( ) het verschil in automatiseringsgraad tussen de betrokken organisaties is klein
( ) het verschil in automatiseringsgraad tussen de betrokken organisaties is zeer klein

I3 Op welke wijze zijn organisatorische veranderingen bij de betrokken organisaties tijdens het ontwerpproces te karakteriseren?

( ) er waren zeer veel organisatorische veranderingen bij alle betrokken organisaties tijdens het ontwerpproces
( ) er waren verschillende organisatorische veranderingen bij bijna alle betrokken organisaties tijdens het ontwerpproces
( ) er waren enkele organisatorische veranderingen bij enkele betrokken organisaties tijdens het ontwerpproces
( ) er was een enkele organisatorische verandering bij een enkele betrokken organisatie tijdens het ontwerpproces
( ) er was geen enkele organisatorische verandering bij alle betrokken organisaties tijdens het ontwerpproces

I4 Op welke wijze is de gemiddelde omvang van de betrokken organisaties tijdens het ontwerpproces te karakteriseren?

( ) > 2000 personen
( ) 500 t/m 1999 personen
( ) 100 t/m 499 personen
( ) 20 t/m 99 personen
( ) < 20 personen

I5 Op welke wijze kan de onzekerheid over de juridische/fiscale status van EDI-berichten tijdens het ontwerpproces worden gekarakteriseerd?

( ) de juridische/fiscale status van de te ontwerpen EDI-berichten speelden zeer sterk mee in het ontwerpproces
( ) de juridische/fiscale status van de te ontwerpen EDI-berichten speelden sterk mee in het ontwerpproces
( ) de juridische/fiscale status van de te ontwerpen EDI-berichten speelden matig mee in het ontwerpproces
( ) de juridische/fiscale status van de te ontwerpen EDI-berichten speelden mee in het ontwerpproces
( ) de juridische/fiscale status van de te ontwerpen EDI-berichten speelden geheel niet mee in het ontwerpproces

EDI ONTWERP SUCCES

J1 Is het ontwerpproces afgesloten met een EDI basis ontwerp?
( ) Ja ———> ga door met J2
( ) Nee ———> ga door met J15

J2 Welke dynamische kwaliteitsattributen zijn in het EDI basisontwerp volledig, dan wel onvolledig gerealiseerd?

	Volledig	Onvolledig
betrouwbaarheid		
juistheid van de berichtenverwerking	[ ]	[ ]
volledigheid van de berichtenverwerking	[ ]	[ ]
geoorloofdheid van de berichtenverwerking	[ ]	[ ]
tijdigheid van de berichten	[ ]	[ ]
continuïteit		
bedrijfszekerheid van het EDI systeem	[ ]	[ ]
veerkracht van het EDI systeem	[ ]	[ ]
herstelbaarheid van het EDI systeem	[ ]	[ ]
degradatiemogelijkheden van het EDI systeem	[ ]	[ ]
uitwijkmogelijkheden van het EDI systeem	[ ]	[ ]
efficiëntie		
snelheid van het EDI systeem	[ ]	[ ]
gebruiksvriendelijkheid van het EDI systeem	[ ]	[ ]
zuinigheid van het EDI systeem	[ ]	[ ]
aansluiting op handmatige procedures	[ ]	[ ]
werkbaarheid van handmatige procedures	[ ]	[ ]
effectiviteit		
dekkingsgraad over bedrijfsfuncties	[ ]	[ ]
beschikbaarheid van het EDI systeem	[ ]	[ ]
bruikbaarheid van het EDI systeem	[ ]	[ ]
ondersteuning voor besluitvorming	[ ]	[ ]
ondersteuning van eindgebruiker	[ ]	[ ]

J3 Welke statische kwaliteitsattributen aangeven zijn in het EDI basisontwerp volledig, dan wel onvolledig gerealiseerd?

	Volledig	Onvolledig
flexibiliteit	[ ]	[ ]
onderhoudbaarheid	[ ]	[ ]
testbaarheid	[ ]	[ ]
portabiliteit	[ ]	[ ]
interne connectiviteit	[ ]	[ ]
externe connectiviteit	[ ]	[ ]
herbruikbaarheid	[ ]	[ ]
geschiktheid infrastructuur	[ ]	[ ]

J4 Heeft het ontwerpproces geresulteerd in een hogere/lagere [1] kwaliteit van het EDI ontwerp dan was voorzien (in het samenwerkingscontract) en wat waren de oorzaken?

Oorzaak 1: ....
....

Oorzaak 2: ....
....

J5 Kunt u de geplande totale kosten (budget) van het EDI ontwerp aangeven door één van de hokjes aan te kruisen?

[ ]	0 - 50.000	[ ]	500.000 - 550.000	[ ]	Meer dan 1.000.000
[ ]	50.000 - 100.000	[ ]	550.000 - 600 000		
[ ]	100.000 - 150.000	[ ]	600.000 - 650.000		
[ ]	150.000 - 200.000	[ ]	650.000 - 700.000		
[ ]	200.000 - 250.000	[ ]	700.000 - 750.000		
[ ]	250.000 - 300.000	[ ]	750.000 - 800.000		
[ ]	300.000 - 350.000	[ ]	800.000 - 850.000		
[ ]	350.000 - 400.000	[ ]	850.000 - 900.000		
[ ]	400.000 - 450.000	[ ]	900.000 - 950.000		
[ ]	450.000 - 500.000	[ ]	950.000 - 1000.000		

J6 Kunt u de werkelijke totale kosten van het EDI ontwerp aangeven door één van de hokjes aan te kruisen?

[ ]	0 - 50.000	[ ]	500.000 - 550.000	[ ]	Meer dan 1.000.000
[ ]	50.000 - 100.000	[ ]	550.000 - 600 000		
[ ]	100.000 - 150.000	[ ]	600.000 - 650.000		
[ ]	150.000 - 200.000	[ ]	650.000 - 700.000		
[ ]	200.000 - 250.000	[ ]	700.000 - 750.000		
[ ]	250.000 - 300.000	[ ]	750.000 - 800.000		
[ ]	300.000 - 350.000	[ ]	800.000 - 850.000		
[ ]	350.000 - 400.000	[ ]	850.000 - 900.000		
[ ]	400.000 - 450.000	[ ]	900.000 - 950.000		
[ ]	450.000 - 500.000	[ ]	950.000 - 1000.000		

J7 Kunt u aangeven in welke mate de oorspronkelijke geplande totale kosten (budget) van het EDI ontwerp overschreden zijn?

( ) geen overschrijding
( ) < 10%
( ) 10 t/m 50%
( ) 50 t/m 100%
( ) > 100%

J8 Heeft het ontwerpproces geresulteerd in minder/meer [2] kosten van het EDI ontwerp dan was voorzien (in het samenwerkingscontract) en wat waren de oorzaken?

Oorzaak 1: ....
....

Oorzaak 2: ....
....

[1] Doorstrepen wat niet van toepassing is.

[2] Doorstrepen wat niet van toepassing is.

J9 Wat was het starttijdstip waarop begonnen werd met het EDI ontwerp?

.... (dag-maand-jaar)

J10 Wat was het geplande levertijdstip van het EDI ontwerp?

.... (dag-maand-jaar)

J11 Wat was het werkelijke levertijdstip van het EDI ontwerp?

.... (dag-maand-jaar)

J12 Kunt u aangeven in welke mate het oorspronkelijk geplande levertijdstip van het EDI ontwerp overschreden is (de verhouding tussen werkelijk levertijdstip minus gepland levertijdstip gedeeld door gepland levertijdstip minus starttijdstip)?

( ) geen overschrijding
( ) < 10%
( ) 10 t/m 50%
( ) 50 t/m 100%
( ) > 100%

J13 Heeft het ontwerpproces geresulteerd in vroeger/later [3] levertijdstip van het EDI ontwerp dan was voorzien (in het samenwerkingscontract) en wat waren de oorzaken?

Oorzaak 1: ....
....

Oorzaak 2: ....
....

J14 Welk belang hecht U aan de kwaliteit, kosten en levertijdstip van het EDI ontwerp? U heeft 100 punten te verdelen over deze drie aspecten. Uiteraard vertegenwoordigt een hoger aantal punten een groter belang!

Kwaliteit van het EDI ontwerp	....	punten
Kosten van het EDI ontwerp	....	punten
Levertijdstip van het EDI ontwerp	....	punten
Totaal	100	punten

———> ga door met K1

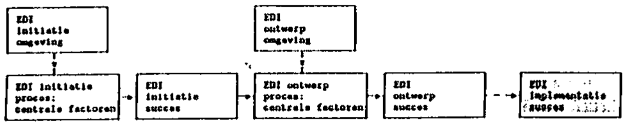
J15 Waarom is het ontwerproces niet afgesloten met een EDI ontwerp?

Oorzaak 1: ....
....

Oorzaak 2: ....
....

———> ga door met K1

[3] Doorstrepen wat niet van toepassing is.



Het doorlezen van de nu volgende tekst maakt het mogelijk de volgende vragen snel in te vullen.

Het ***EDI implementatieproces*** bestaat uit activiteiten die tot doel hebben te komen tot een geïmplementeerd EDI systeem. De besturing van het implementatieproces verloopt aan de hand van een aantal centrale factoren. Deze factoren worden in deze enquête niet meegenomen.
Onder ***EDI implementatie succes*** wordt verstaan de mate waarin de in het EDI basisontwerp gespecificeerde kwaliteit, kosten en levertijd van het te implementeren EDI systeem worden gerealiseerd.

EDI IMPLEMENTATIE SUCCES

K1 Is er een EDI systeem geïmplementeerd?

( ) Ja ———> ga door met K2
( ) Nee ———> ga door met K15

K2 Welke dynamische kwaliteitsattributen van het EDI systeem zijn volledig, dan wel onvolledig geïmplementeerd?

	Volledig	Onvolledig
betrouwbaarheid		
juistheid van de berichtenverwerking	[ ]	[ ]
volledigheid van de berichtenverwerking	[ ]	[ ]
geoorloofdheid van de berichtenverwerking	[ ]	[ ]
tijdigheid van de berichten	[ ]	[ ]
continuïteit		
bedrijfszekerheid van het EDI systeem	[ ]	[ ]
veerkracht van het EDI systeem	[ ]	[ ]
herstelbaarheid van het EDI systeem	[ ]	[ ]
degradatiemogelijkheden van het EDI systeem	[ ]	[ ]
uitwijkmogelijkheden van het EDI systeem	[ ]	[ ]
efficiëntie		
snelheid van het EDI systeem	[ ]	[ ]
gebruiksvriendelijkheid van het EDI systeem	[ ]	[ ]
zuinigheid van het EDI systeem	[ ]	[ ]
aansluiting op handmatige procedures	[ ]	[ ]
werkbaarheid van handmatige procedures	[ ]	[ ]
effectiviteit		
dekkingsgraad over bedrijfsfuncties	[ ]	[ ]
beschikbaarheid van het EDI systeem	[ ]	[ ]
bruikbaarheid van het EDI systeem	[ ]	[ ]
ondersteuning voor besluitvorming	[ ]	[ ]
ondersteuning van eindgebruiker	[ ]	[ ]

K3 Welke statische kwaliteitsattributen van het EDI systeem zijn volledig, dan wel onvolledig geïmplementeerd?

	Volledig	Onvolledig
flexibiliteit	[ ]	[ ]
onderhoudbaarheid	[ ]	[ ]
testbaarheid	[ ]	[ ]
portabiliteit	[ ]	[ ]
interne connectiviteit	[ ]	[ ]
externe connectiviteit	[ ]	[ ]
herbruikbaarheid	[ ]	[ ]
geschiktheid infrastructuur	[ ]	[ ]

K4 Heeft het implementatieproces geresulteerd in een hogere/lagere [4] kwaliteit van het geïmplementeerde EDI systeem dan was voorzien (in het EDI ontwerp)?

Oorzaak 1: ....
....

Oorzaak 2: ....
....

K5 Kunt u de geplande totale kosten (budget) van het geïmplementeerde EDI systeem aangeven door één van de hokjes aan te kruisen?

[ ]	0 - 50.000	[ ]	500.000 - 550.000	[ ]	Meer dan 1.000.000
[ ]	50.000 - 100.000	[ ]	550.000 - 600 000		
[ ]	100.000 - 150.000	[ ]	600.000 - 650.000		
[ ]	150.000 - 200.000	[ ]	650.000 - 700.000		
[ ]	200.000 - 250.000	[ ]	700.000 - 750.000		
[ ]	250.000 - 300.000	[ ]	750.000 - 800.000		
[ ]	300.000 - 350.000	[ ]	800.000 - 850.000		
[ ]	350.000 - 400.000	[ ]	850.000 - 900.000		
[ ]	400.000 - 450.000	[ ]	900.000 - 950.000		
[ ]	450.000 - 500.000	[ ]	950.000 - 1000.000		

K6 Kunt u de werkelijke totale kosten van het geïmplementeerde EDI systeem aangeven door één van de hokjes aan te kruisen?

[ ]	0 - 50.000	[ ]	500.000 - 550.000	[ ]	Meer dan 1.000.000
[ ]	50.000 - 100.000	[ ]	550.000 - 600 000		
[ ]	100.000 - 150.000	[ ]	600.000 - 650.000		
[ ]	150.000 - 200.000	[ ]	650.000 - 700.000		
[ ]	200.000 - 250.000	[ ]	700.000 - 750.000		
[ ]	250.000 - 300.000	[ ]	750.000 - 800.000		
[ ]	300.000 - 350.000	[ ]	800.000 - 850.000		
[ ]	350.000 - 400.000	[ ]	850.000 - 900.000		
[ ]	400.000 - 450.000	[ ]	900.000 - 950.000		
[ ]	450.000 - 500.000	[ ]	950.000 - 1000.000		

K7 Kunt u aangeven in welke mate de oorspronkelijke geplande totale kosten (budget) van het geïmplementeerde EDI systeem overschreden zijn?

( ) geen overschrijding
( ) < 10%
( ) 10 t/m 50%
( ) 50 t/m 100%
( ) > 100%

[4] Doorstrepen wat niet van toepassing is.

K8 Heeft het implementatieproces geresulteerd in minder/meer [5] kosten dan was voorzien (in het EDI ontwerp) en wat was daarvan de oorzaak?

Oorzaak 1: ....
....

Oorzaak 2: ....
....

K9 Wat was het starttijdstip waarop begonnen werd met de implementatie van het EDI systeem?

.... (dag-maand-jaar)

K10 Wat was het geplande levertijdstip van het geïmplementeerde EDI systeem?

.... (dag-maand-jaar)

K11 Wat was het werkelijke levertijdstip van het geïmplementeerde EDI systeem?

.... (dag-maand-jaar)

K12 Kunt u aangeven in welke mate het oorspronkelijk geplande levertijdstip van het geïmplementeerde EDI systeem overschreden is (de verhouding tussen werkelijk levertijdstip minus gepland levertijdstip gedeeld door gepland levertijdstip minus starttijdstip)?

( ) geen overschrijding
( ) < 10%
( ) 10 t/m 50%
( ) 50 t/m 100%
( ) > 100%

K13 Heeft het implementatieproces geresulteerd in een vroeger/later [6] levertijdstip van het geïmplementeerde EDI systeem dan was voorzien (in het EDI ontwerp) en wat waren de oorzaken?

Oorzaak 1: ....
....

Oorzaak 2: ....
....

[5] Doorstrepen wat niet van toepassing is.

[6] Doorstrepen wat niet van toepassing is.

K14 Welk belang hecht U aan de kwaliteit, kosten en levertijdstip van het geïmplementeerde EDI systeem? U heeft 100 punten te verdelen over deze drie aspecten. Uiteraard vertegenwoordigt een hoger aantal punten een groter belang!

Kwaliteit van het geïmplementeerde EDI systeem	....	punten
Kosten van het geïmplementeerde EDI systeem	....	punten
Levertijdstip van het geïmplementeerde EDI systeem	....	punten
Totaal	100	punten

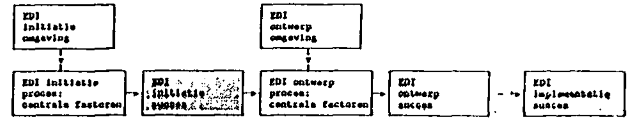
———> ga door met L1

K15 Waarom is er geen EDI systeem geïmplementeerd?

Oorzaak 1: ....
....

Oorzaak 2: ....
....

———> ga door met L1



In het volgende deel zijn er vragen waarbij antwoorden dienen te worden aangekruist op de schalen onder de vraag (vijf antwoordmogelijkheden per vraag).
U vult dus op de schaal één van de vijf waarden tussen de beide extremen in.

SUBJECTIEF EDI INITIATIE-, ONTWERP- EN IMPLEMENTATIESUCCES

EDI initiatie succes

L1 Beoordeelt U het samenwerkingscontract, als resultaat van het initiatieproces, als falend of succesvol?

zeer falend ☐☐☐☐☐ zeer succesvol

EDI ontwerp succes

L2 Beoordeelt U het EDI ontwerp, als resultaat van het ontwerpproces, als falend of succesvol?

zeer falend ☐☐☐☐☐ zeer succesvol

EDI implementatie succes

L3 Beoordeelt U het geïmplementeerde EDI systeem, als resultaat van het implementatieproces, als falend of succesvol?

zeer falend ☐☐☐☐☐ zeer succesvol

APPENDIX 2

Appendix 2: *some data from the contracting and design process of the investigated EDI projects.*

Project number	Contracting process: start date	date due	months	Design process: design costs planned (guilders)	design costs actual (guilders)	start date	date due planned	date due actual	months
1	09/89	11/90	15	-	-	-	-	-	-
2	06/90	06/90	1	50/100,000	50/100,000	09/90	12/90	03/91	7
3	09/89	-	-	0/ 50,000	0/ 50,000	12/90	06/91	10/91	11
4	/89	09/89	-	500/550,000	500/550,000	09/89	03/90	03/90	7
5	/83	04/87	-	50/100,000	100/150,000	04/87	12/87	08/88	17
6	10/90	01/91	4	100/150,000	100.150,000	03/91	05/91	06/91	4
7	10/90	10/90	1	50/100,000	50/100,000	10/90	10/91	02/92	16
8	11/89	07/90	9	400/450,000	-	09/90	10/90	11/90	3
9	07/90	-	-	-	-	-	-	-	-
10	11/88	-	-	100/150,000	200/250,000	11/89	06/90	07/90	9
11	12/88	06/90	19	150/200,000	100/150,000	06/90	12/90	01/91	8
12	01/89	-	-	-	-	-	-	-	-
13	06/87	12/87	7	>1,000,000	>1,000,000	10/87	01/88	02/88	5
14	/83	03/88	-	150/200,000	250/300,000	03/88	-	-	-
15	12/87	06/88	7	450/500,000	750/800,000	01/88	06/89	02/90	26
16	02/89	-	-	50/100,000	50/100,000	02/89	09/89	09/89	8
17#	/87	-	-	150/200,000	450/500,000	/88	/89	/89	-
18	06/90	-	-	50/100,000	50/100,000	09/91	12/91	02/92	6
19	/86	-	-	200/250,000	400/450,000	05/85	09/86	01/87	20
20	/88	11/91	-	100/150,000	100/150,000	01/91	04/91	11/91	11
21	12/87	06/88	7	250/300,000	250/300,000	06/88	12/88	12/88	7
22	/89	-	-	50/100,000	50/100,000	02/90	06/90	06/90	5
23#	/89	/89	-	-	-	/89	/89	-	-
24	10/88	03/89	6	150/200,000	150/200,000	04/89	10/89	12/89	9
25	/74	09/91	-	250/300,000	250/300,000	10/91	12/91	01/92	4
26	12/89	-	-	100/150,000	100/150,000	04/89	12/89	01/90	9
27	/88	12/89	-	300/350,000	600/650,000	07/87	12/88	06/89	24
28	/83	-	-	>1,000,000	>1,000,000	12/90	08/91	01/92	14
29	06/90	-	-	400/450,000	850/900,000	05/90	08/90	01/91	9
30*	06/87	05/90	36	600/650,000	800/850,000	11/87	12/88	12/88	14
31	12/90	-	-	>1,000,000	>1,000,000	01/91	11/91	11/91	11
32	06/88	-	-	200/250,000	300/350,000	01/89	06/89	09/89	9
33	/84	-	-	>1,000,000	>1,000,000	11/84	12/88	09/89	59
34	/90	/90	-	>1,000,000	>1,000,000	02/90	03/91	06/92	29
35#	/84	/85	-	-	-	/84	07/84	07/84	-
		Average	7.6					Average	12.9

* In this case the date the contracting process was due was indicated at a time later than the starting date of the design process. This case is not taken into the calculation of the average time.

\# In those cases it was possible to indicate the time excess of the design process, but not the exact actual date due.

ACKNOWLEDGEMENTS

When I was a computer programmer working in informatization projects I was fascinated to know how these projects were managed. Although the information systems were not bad, from a programmer's point of view, most projects were not very successful. I discovered that in the Netherlands, as well as abroad, fewer empirical studies focused on how people actually design information systems and how these can be managed. In practice, the speciality of Information Management is dominated by prescriptive models which are sometimes atheoretical. The field is dominated by judgements like 'you have to use this development method, data model, computer type, and so on.' Lack of falsifiable and useful descriptive models related to design is, I think, one of the key reasons for our failure to understand the successes and failures of information systems. This lack of knowledge is also visible in the design of interorganizational information systems, like EDI systems. This study develops a falsifiable and useful descriptive theory about design management of EDI systems. Whether these ideas are accepted will depend on the strength of my arguments and the willingness of the reader to accept my ideas.

The ideas in this study evolved during continuous discussions with my two promotors. I would like to thank Dré Kampfraath. He stimulated me to both start and finish this research project. He taught me to conceptualize my, sometimes chaotic, ideas. I would also like to thank Peter Zuurbier who inspired me continuously and taught me to focus on research methodology. In our discussions we concentrated on theoretical inquiry and practical usefulness.

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Eric van Heck Wageningen/Nijmegen, May 1993.

CURRICULUM VITAE

Eric van Heck was born on May 19th 1960 in Veghel (The Netherlands). After his secondary school education in Veghel, he studied at Wageningen Agricultural University and obtained his Ir. degree in January 1985. His majors were Land- and water use, Computer science, Operational Research, and Agricultural Economics. Part of his study was done at Cornell University, Ithaca (USA). In March 1985 he joined Cap Gemini Nederland as a programmer. In August 1987 he accepted the position of Assistant Professor at the department of Management Studies of Wageningen Agricultural University. His education and research interests are related to Information Management. He is secretary of the university working group on Information Management. He is a co-author of books on Information Management ('Bestuurlijke Informatiekunde' and 'Bestuurlijke Informatiekunde in kort bestek') and on Management of Organizations ('Besturen van Organisaties'). He has co-edited books on Business Administration and Agribusiness ('Bedrijfskunde en Agribusiness'), Strategic Cooperation ('Strategische samenwerking') and on Scientific Research on EDI. He has also written a number of scientific articles. He was a member of the editorial board of Agro-Informatica and is member of Edispuut.

SUBJECT INDEX

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