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A dynamic hierarchical structural model of information systems success:
The case of Electronic Data Interchange

by

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January 1992

A Thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements of the degree of Doctor of Philosophy.

ISBN 0-315-74623-8

In Memory of My Father

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ACKNOWLEDGEMENTS

I would like to thank Prof. D. Drury who supervised this dissertation. His critical and incisive approach helped shape the mosaic of the dissertation. I am very much indebted to him for providing intellectual stimulation and academic guidance.

Many thanks go to Prof. C. Wrigley who spent many hours helping me formulate the basic research questions. He also helped me regain my fortitude when I needed it most. I am very grateful to him.

Prof. R. Kanungo not only taught me Organizational Behaviour, but also aroused my interest in the subject matter. I am grateful to him for inspiration and motivation.

Prof. L. Lefebvre of École Polytechnique was instrumental in assisting me focus on the major research questions. I would like to thank him for motivation and encouragement.

Apart from the members of my committee, many other people contributed to the completion of this work. In particular, I would like to thank Prof. M. Yalovsky for all his support during my studies at McGill.

I would also like to thank Prof. G. Johns of Concordia University for his assistance during the questionnaire design, and Professors J. Etezadi, T. K. Mak, and J. Tomberlin for their help in statistical analyses. I am also grateful to Mrs. S. Callaghan, who fastidiously edited drafts of the dissertation.

The support of the *EDI Council of Canada* and the *Canadian Information Processing Society* for making their list of membership available is also greatly appreciated.

Finally, my sincere gratitude go to all 382 managers who filled out the questionnaire. Without their help this project would have not been possible.

ABSTRACT

The purpose of this dissertation is to explicate the meaning of information systems (IS) success in the realm of a dynamic hierarchical structural model of IS success. Through an empirical study of 382 firms using internal and Electronic Data Interchange (EDI) systems, different characteristics of this model are examined via four hypotheses.

First, using linear structural modelling techniques, it is shown that successful information systems share certain properties common to all systems, in addition to certain properties specific to each class of systems. Four generic factors influencing IS success are identified as i) output reliability, ii) system's characteristics, iii) efficiency outcomes, and iv) users' requirements. Second, the role of time in the IS adoption and assessment process is explored. By comparing firms that have adopted EDI with those that have not adopted EDI, it is shown that the decision maker's perception of IS success changes during different stages of the adoption and assessment process. Third, the role of stakeholders in the assessment process is examined by comparing perceptions of different managerial groups based on their educational background, management echelon, and functional area. It is shown that different stakeholders evaluate the success of IS differently. Finally, through an examination of various types of evaluation functions, it is shown that IS success is a multi-dimensional construct.

Overall, cross-group comparisons of the dynamic hierarchical structural model

of IS success provide sufficient evidence regarding the instability of IS success across time, type of system, and stakeholders involved in the evaluation process.

In addition to the major hypotheses, two corollaries have also been examined. It is shown that user involvement in an IS project has a positive effect on the system's success. Further, the results of the study indicate that respondents in smaller companies are more satisfied with the support and services of the MIS department than their counterparts in larger companies.

Finally, by comparing three versions of the questionnaire used in the study, it is shown that question order has a significant effect on responses. The implications of this finding for survey studies are discussed.

CHAPTER 1 - INTRODUCTION

Historically, two simplifying assumptions have permeated MIS research. First, MIS scholars have treated the firm as a stand-alone unit of analysis (McFarlan, 1988), thus limiting the domain of the discipline primarily to intra-corporate systems. Second, almost all empirical studies related to assessment of information systems (IS) success have been conducted after the completion of the system, therefore ignoring the effect of temporal setting or its correlates on the decision maker's judgement.

The first assumption has been attenuated because of the recent technological, economic, and organizational changes. These have in turn prompted a growing number of firms to coordinate their interorganizational relations either by forming new types of IT alliance or by solidifying their existing intercorporate ties through telecommunication links (Barrett and Konsynski, 1982).

Although there is a paucity of data regarding the prevalence of interorganization information systems (IOS), evidence relating to proliferation of a specific form of interorganization systems, Electronic Data Interchange (EDI), is overwhelming. It is estimated that EDI is growing at a compound annual rate of 26% (EDI Research, 1989). The reason for this proliferation is the amount of paper involved in business transactions. Estimates are that, on average, 30 documents are required to carry out a business transaction. This translates into a total amount of 30 billion corporate-to-corporate messages per year in the United States alone (SRI, 1986). Since the handling and distribution of business transactions is a slow, labourintensive, and error-prone process, a growing number of companies have turned to EDI as a fast, efficient, and reliable means to create and distribute intercorporate transactions. It is estimated that the number of firms using EDI will increase to 10,500 in 1991 (Schanz, 1988). This figure represents one-third of large companies in the U.S. (Computerworld, 1989). Besides the growing number of firms involved, the demand for EDI is expected to expand exponentially in the future as a wider array of transaction sets is adopted by participating firms. As a consequence, the spending on EDI software and services is expected to grow an average of 88% annually to a projected level of $1.9 billion in 1992 (Campbell, 1987).

Although EDI has been under active development since the mid 1960s, MIS literature is by and large devoid of substantial research effort in this area. The few related studies have primarily been prescriptive in nature, and have paid very little attention to the conceptual development or methodological issues. In view of a lack of solid theoretical underpinning, we still have inadequate scientific explanation as to why firms establish electronic links, what impacts interorganizational systems have on various dimensions of the existing interorganizational relations, or what factors lead to the successful development and implementation of these systems.

Similarly, the tenet underlying the second assumption regarding the ex-post assessment of IS has been challenged because of the methodological problems surrounding one-shot, ex-post surveys. Even though the literature on cognitive psychology and organizational behaviour points to a large number of sources of bias which could affect the human information processing cycle (Hogarth and Makridakis, 1981), no MIS study has examined whether the decision maker's perceptions about the success of an information system changes during various stages of the adoption process. As a result, our picture of the information technology adoption process is primarily based on the evaluation of the outcomes of the adopted system, without taking into account the potential effect of temporal setting or other sources of bias.

1. RESEARCH HYPOTHESES

This primary objective of this dissertation is to investigate the major issues regarding the evaluation of information systems success, focusing on four broad research questions.

H1: The success of external and internal systems share certain structural properties.

It is maintained that IS success is based on a hierarchical structural model that encompasses i) a set of properties shared by all systems, and ii) a set of specific properties unique to each class of systems. It is shown that one of the major problems with the existing scales of IS success is that they have been applied to a wide range of systems without taking into account the specific properties of these systems.

H2: The decision maker's perception of the success of IS changes during various stages of the adoption process.

Based on the literature on psychology, it is maintained that the informational base of the decision maker changes between the persuasion and confirmation stages of the adoption decision process (Rogers, 1983). The major source for this change is the subject's varying degree of knowledge about the outcomes of the adoption. As the firm gets closer to the implementation of the system, the decision maker becomes more knowledgeable about the outcomes of the system under study. This, combined with different judgemental biases could affect the decision maker's perceptions of the system's success. In support of the basic premise of the above hypothesis, it is argued that we require different success measures at different stages of an IS adoption process. The generalizability of most of the measures of MIS success is therefore questioned because these measures are mainly based on ex-post perceptions of respondents. This hypothesis is tested by comparing the decision maker's perceptions of the factors influencing IS success among firms that have adopted a particular type of information technology with those that are in the process of adopting or have not yet adopted the technology.

H3: Different stakeholders evaluate the success of an IS differently.

The role of stakeholders in the assessment process is examined through the above hypothesis. This hypothesis is tested by comparing the perceptions of different managerial groups based on their educational background, management echelon, and functional area.

H4: IS success is a multi-dimensional construct.

The final hypothesis relates to the multi-dimensionality of IS success. Based on the hierarchical structural model of IS success, it is hypothesized that IS success is multi-dimensional construct.

In addition to these four hypotheses, the role of user involvement in the evaluation process is also examined through the following proposition.

P1: User involvement affects the decision maker's perception of IS success.

It is argued that active participation in the adoption decision making process changes the total informational base that constitutes the decision maker's attitude towards the adopted system (Fishbein and Ajzen, 1975). Those who have participated in the adoption process have a better knowledge of the outcomes of the innovation. However, they are expected to exhibit a greater extent of bias, particularly in attributing success to their own efforts and skills, and in having an illusory feeling of control over the outcomes of the innovation.

2. THEORETICAL BACKGROUND

Several germane fields of study are employed as the theoretical foundation of this dissertation. First, the transaction costs approach (Williamson, 1975; 1981; 1985) is used as the basic unit of analysis in explaining electronic linkage between firms. Second, the four structural dimensions of interorganizational relations (Marrett, 1971) are described in order to highlight the organizational impacts of IOS. Third, selected research in psychology (e.g., Fishbein and Ajzen, 1975; Anderson and Jacobson, 1965) and innovation (e.g., Rogers, 1983) is employed to gain an insight into various stages involved in the adoption-decision process. Particular attention is paid to the role that the decision maker's perceptions and attitudes play in this process, and the sources of information processing bias that affect human judgement. Finally, MIS research (e.g., Lucas, 1975a; 1981) is used to identify the factors that influence the success of information systems.

Altogether, the above body of literature is used to examine the concept of IS success. In the process, two models are developed: i) a hierarchical structural model of IS success, and ii) a conceptual model of formation, adaptation and maintenance of IOS. The underlying tenet of these models is further expounded in the realm of the theory of reasoned action (Fishbein and Ajzen, 1975), sources of information processing bias (Hogarth and Makridakis, 1983), the innovation framework (Rogers, 1983), and MIS success.

The major hypotheses is tested via a survey of firms that are at different stages of EDI adoption process. Perceptions of the respondents regarding the success factors of internal systems are also gathered in order to test the second hypothesis regarding the hierarchical structure of IS success. A cross examination of perceptions of different stakeholders is used to test the third hypothesis. Finally, a comparison of different types of evaluation is made in order to provide empirical evidence in support of the last hypothesis.

3. ORGANIZATION OF THE DISSERTATION

The dissertation is organized into eight chapters. A critical examination of the concept of IS success is presented in Chapter 2 in order to explicate the concept of IS success. First, based on the literature on philosophy of science, an epistemological analysis of the concept of success is provided. Second, basic properties of successful systems have been identified. Third, a conceptual framework of IS success, along with relevant methodological issues is discussed. Particular attention is paid to the assumptions underlying the IS assessment literature. Issues related to measurement and operationalization of IS success are discussed, and the existing measurement instruments are evaluated.

In Chapter 3, the common basic properties of successful internal and external systems, as well as specific characteristics of external systems are identified. A hierarchical model of IS success, which identifies generic as well as specific properties of successful systems, is subsequently presented. It is argued that all successful systems share certain properties that relate to general aspects of systems. In addition, each class of systems possesses certain unique properties that relate to specific characteristics of those systems. In light of this, it is contended that because of the hierarchical nature of IS success, we need different measures for different classes of information systems.

In Chapter 4, literature from psychology, organizational behaviour, and diffusion of innovation is employed to develop the theoretical groundwork necessary for the investigation of the role of time in the information technology adoption process. The temporal orientation of individuals and their effects on information acquisition and use are examined. Major sources of bias that affect a decision maker's informational base are identified, and pertinent measurement issues are discussed. It is contended that by measuring IS success retrospectively, MIS researchers have ignored the dynamic role that time plays in the adoption process.

Issues related to research design and measurement are discussed in Chapter 5. First, the research design of the dissertation is presented. Second, steps involved in developing the measuring instrument used in the study are explained. Third, an overview of various statistical analyses employed in the study are provided. Next, sampling procedures along with pertinent methodological issues are discussed. Then, sample characteristics along with various aspects of EDI programs in adopting firms are presented. Finally, it is shown that the results are not affected by non-response bias.

Empirical evidence regarding the four research hypotheses is provided in Chapter 6.

In chapter 7, three corollaries that have important implications for IS research are discussed. First, the role of user involvement in IS success is explored. Then, the role of the firm's size in influencing respondents' perceptions is explored. Finally, methodological issues pertaining to ordering of questions on responses are discussed.

Summary and conclusions are presented in Chapter 8. The limitations of the study are highlighted. The theoretical and practical contributions of the dissertation are discussed.

CHAPTER 2 - A CRITICAL EXAMINATION OF THE CONCEPT OF INFORMATION SYSTEMS SUCCESS

The purpose of this chapter is to provide a critical examination of the concept of IS success. It consists of four sections. The first section provides an epistemological analysis of the concept of success. Pertinent literature in philosophy of science is used to explicate the meaning of purpose. It is shown that the concepts of *purpose* and *success* share a common structural function. Within the confines of an assessment matrix, the requisite features of the notion of success are then employed to provide an operational definition.

The second section focuses on IS success, tying the IS literature to the conceptual and methodological specificities of the concept of success. A definition of information technology (IT) is provided, and a case of IS success is illustrated. Based on the literature, conceptual framework of IS success is developed and related methodological issues are discussed.

The third section provides a critical analysis of research in the area of assessment of IS success. Linking the literature to the concept of IS success, the assumptions underlying this research are critiqued, pertinent issues related to measurement and operationalization of IS success are discussed, and various instruments used in the measurement of IS success are compared. These discussions are used to uncover the ambiguities surrounding the related conceptual and methodological issues.

1. SUCCESS: AN EPISTEMOLOGICAL PERSPECTIVE

This section provides an epistemological treatment of the concept of success. First, *success* is defined and its requisite attributes are identified. Next, an assessment matrix is employed to explain how the benchmarks with which success is being assessed are established. These discussions are then used to draw a parallel between the concepts of *success* and *winning*. It is shown that the assessment of various activities such as sports, auctions, tournaments, and elections can be classified along two major dimensions: evaluation function and performance benchmark. Finally, the foregoing discussions are adapted to the concept of IS success. An operational definition of the concept is presented, then the basic requirements for its assessment are highlighted.

1.1. What Is Success?

The accomplishment of what was aimed at.
Oxford English Dictionary

The favourable or prosperous termination of attempts and endeavours.
Random House Dictionary

The first definition of success revolves around the attainment of a pre-established goal: as long as the goal is accomplished the endeavour is defined as successful. The second definition focuses on the termination of an attempt in a favourable manner.

From the literature in philosophy of science, an interesting parallel between the concepts of *success* and *purpose* is revealed. As was just discussed, success refers to the accomplishment of a goal. Similarly, purpose refers to a behaviour that is directed to the attainment of a goal (Rosenblueth, Wiener, and Bigelow, 1943). In order to gain a better insight into the connection between these two concepts, it is instructive to examine the interrelationships between behaviour, purpose, and teleology. The classification of behaviour provided by Rosenblueth, Wiener, and Bigelow (1943), which is presented in Figure 2.1 along with a short description of the important terms, will further enhance our understanding of the concepts of success and purpose.

One of the key contentions of Rosenblueth et al.'s essay is that certain types of entities, such as a torpedo with a target-seeking mechanism, are *intrinsically* purposeful - i.e., they are servomechanisms. In contrast, although some other devices such as a clock or a roulette are designed with a purpose, they are not purposeful - i.e., there is no final condition for which the device is striving.

In a critique of Rosenblueth et al.'s paper, Taylor (1950a) contends that, given the limits of accuracy of measuring instruments, it is the knowledge of the causal factors involved in behaviour of objects that allows the prediction of the final condition of these objects. More precisely, the study of the relationship between the behaving object and the goal towards which that object is directing itself is not conceivable as long as human purposes are left out. Purposefulness or purposelessness then are not attributable to the object, but only to the being who uses the object *for* a purpose.

Figure 2.1. Classification of Behaviour

- Bahavior
  - Active
    - Purposeful
      - Feedback
        - Predictive
          - First order
          - Second, etc.
        - Non-predictive
      - Non-feedback
    - Non-purposeful
  - Non-active

Behaviour.	Any change of an entity with respect to its surrounding.
Active.	A behaviour n which the object is the source of the output energy involved in a given specific reaction.
Purposeful.	An active behaviour that is directed to the attaintment of a goal - i.e., to a final condition in which the behaving object reaches a definite correlation in time or space with respect to another object or event.
Feedback.	When some of the output energy is returned as input, the active purposeful behaviour is said to have feed-back or to be teleological.
Predictive.	Feedback purposeful behaviour is predictive (extrapolative) if it responds to temporal and at least one spatial changes.
First order	If an object merely predicts the path of its target, then the behaviour is of first-order prediction. If, on the other hand, both the path of the object and that of the target have to be foreseen, then the behaviour is of second-order prediction.

In a rebuttal of this critique, Rosenblueth and Wiener (1950) assert that in the study of purpose, it is possible to grant mechanical devices the power of striving toward a goal, irrespective of human purposes. As an example, they cite a radar-controlled gun, whose purpose would be different from that of the designer when it behaves in a way different from what the designer had originally had in mind. They maintain, however, that:

> *...the notion of purpose is not absolute, but relative; it admits degrees... It involves a human element, namely the attitude and objectives of the observer. Different observers may well differ in the evaluation of the degree of the purposefulness of a given behaviour. And the same observer may study a given behaviour as purposeful or purposeless, with different objectives.*
>
> (Rosenblueth and Wiener, 1950, p. 323)

In their final remarks, Rosenblueth and Wiener outline several criteria for the distinction between purposeful and non-purposeful behaviour, among which are:

a) The acting object of a purposeful behaviour is oriented or guided by a goal.

b) Purposeful behaviour is to be attributed to an object that is coupled with other objects in the environment.

c) The acting object of a purposeful behaviour is required to register message from its surrounding, i.e., it has to be coupled with the goal.

d) In order to eliminate random coincidence, purposeful behaviour should be observed several times with the system exposed to different initial or subsequent conditions.

In a rejoinder, Taylor (1950b) identifies one of the major difficulties with cybernetic view of purpose as that of requiring that the goal be some existing object or feature in the environment of the behaving entity. He cites the examples of the knight seeking the Holy Grail or a man going to refrigerator for an apple which he erroneously believes to be there. In these cases, he asserts (p. 328), "*... there does not exist* the requisite object or feature in the environment of the purposeful entity with respect to which it ever does, or can, attain a 'final condition,' and which can thus, by the criterion offered, be designated 'the goal' of that object." In the final analysis, Taylor specifies the following necessary and sufficient conditions for any given behaviour pattern to be *purposive* (p. 330):

> *... to say of a given behaviour pattern that is purposeful, is to say that the entity exhibiting that behaviour desires some goal, and is behaving in a manner it believes appropriate to the attainment of it.*

Churchman and Ackoff (1950), in a similar study of purposive behaviour and cybernetics, take note of the following four similarities between servomechanisms, psychological behaviour, and social groups.[1]

a) The objects and environments need not, in the sense of classical mechanics, be *rigidly* specified. The studies of purposeful behaviour do not require mechanically defined specifications for the experiment.

b) *Choice* is an essential element in identification of purpose. If the environment is rigidly defined, then no choices can be made.

c) Purposive behaviour can be studied only relative to *a period of time*, for purpose implies action and change.

d) The purposive object should be at least a potential *producer* of some end-result; examples being the machine that computes, the man who writes a poem, and a social group that acts in a certain way in order to reach some objective. This demand for potential productiveness therefore requires that

[1] For sake of brevity, hereafter, the term *object* will be used to denote servomechanisms, psychological behaviour, or social groups.

in studying purposive object or behaviour, the notion of production or a similar concept should be included.

Churchman and Ackoff maintain that (p. 35): "All purposive schema must incorporate the notion of an object (individual) having choices of behaviour all of which are at least potentially producers of some end-result."

Having reviewed the concept of *purpose* from a scientific/philosophical point of view, we will now examine the implications of this concept for *success*. This epistemological examination will not only elucidate the meaning of success, but also help identify the structural function of the concept.

A comparison of the definitions of purpose and success reveals that a) a purposive object is directed to the attainment of an end-result, and b) the favourable attainment of the goal or end-result culminates in success of the object. A provision regarding one of the contentious issues surrounding the concept of purpose is made, however. It is maintained that in order to assess success, there must exist an object or feature in the environment with which the behaving object strives to attain a certain correlation. In other words, the goal must exist in the surrounding of the behaving object. More precisely, given the striking similarity between the definitions of purpose and success, it is contended that purposefulness is a *sine qua non* for achieving success, i.e., *an object can be successful only and only if it is first purposeful.* As an extension to this proposition, the following principal characteristics of successful entities are identified:

a) The notion of success is *relative.*

b) The notion of success involves the *attitude and objectives of the observer.*

c) There should be a *final condition (goal(s))* towards which the object is striving.

d) In producing the *favourable end-result,* the object must have *choices of behaviour.*

e) The object must be *coupled* to the goal.

f) The object must be *coupled* to the other objects in the environment.

g) The notion of success is *time-dependent* in that it is affected by changes in the goal, environment, or the observer's attitudes and objective.

Based on these principal characteristics, three basic properties of successful objects are identified. These properties are shown in Table 2.1.

Table 2.1. Basic Properties of Successful Objects

1. Goal-oriented
2. Attitude-dependent
3. Time-dependent

These basic properties provide a general framework within which the requisites of success can be studied. However, we still need to focus on the benchmarks with which success is being assessed, and how the assessment process is being carried out.

1.2. Assessment Matrix

In order to explicate the concept of success more fully, it is useful to draw a parallel between the concepts of success and winning.[2] We classify various competitive sports and other competitive activities such as auctions, tenders, tournaments, and elections along two major dimensions: evaluation function and performance benchmark. The evaluation functions of these activities are based on either a uni-component or a multi-component criterion. Performance, on the other hand, is based on relative or absolute benchmarks. The resulting 2x2 assessment matrix will allow identification of the principal components of the concept of success. As a way of illustration, we first concentrate on competitive sports, then extend our discussion to other competitive activities.

1.2.1. Evaluation Function

From a systems theory perspective, we can view organizations, subunits, and individuals as purposeful systems (Churchman, 1971). Since purposeful systems have goals, then we require measures of performance that can assess how well a system is attaining its goals. In another words, a criterion is needed. A criterion is defined by Horst et al. (1936) as "the measure of success or failure in an activity ...", and by Nagle (1953) as "... an index by which we can measure the degree of success ..."

Sports and other competitive activities are assessed using either a uni-component criterion or a multi-component criterion. Sports such as running, skiing,

---

[2] Winning is defined in Random House Dictionary as "that brings victory or advantage."

car racing, and swimming are judged according to one evaluative component: the time that it takes the participant(s) to finish the race. Similarly, the winners of such field sports as hockey, football, and basketball are determined by only one evaluative component: the number of points (or goals) obtained in a fixed amount of time. Yet another set of sports such as volleyball, tennis, and golf depend on the attainment of certain points, irrespective of time. All these sports are easy to administer provided that the players adhere to the rules. Apart from occasional incidents creating disagreement about certain conducts of the game, there is no need for expert judgement in these games. The factor discriminating between winners and losers is the principal evaluative component (e.g., time) on which the games are assessed.

On the other hand, sports such as skating, gymnastics, and diving are judged via a multi-criteria process. Several judges evaluate the performance of the participants based on a set of pre-established criteria. In contrast to assessment based on uni-component evaluation function, multi-component criteria assessment usually relies heavily on the subjective evaluation of the judges. A certain evaluative scheme (e.g., additive or multiplicative) is in turn used to calculate the overall performance of the players.

It should be recognized that, regardless of the type of evaluation function of a competitive sport, all athletes try to attain a pre-defined static or dynamic goal. As such, irrespective of their evaluation functions, athletes are purposive beings who a) are coupled with their environments and their goals in such a manner that changes in surroundings (e.g. other players or the goal itself) will modify their behaviour, and

b) strive to terminate their endeavours in a favourable manner.

As Rosenblueth and Wiener (1950) have argued, the evaluation of the degree of purposefulness of a given behaviour is relative, and it involves human beings. It should be noted that within the limits of the measuring instrument, the assessment of the degree of success of the sports with a uni-component evaluation function can be performed more accurately than those with a multi-component evaluation function. Therefore the latter class of sports is less susceptible than the former class to the involvement of individuals who are external to the activity. This state of affairs, however, does not negate the requisite of relativity of success as the players themselves evaluate the degree of their success differently, based on their objectives in a given game. A contestant may, for example, set different objectives depending on whether he or she is competing in a regional, national, or international game.

The two types of evaluation functions presented here are somewhat similar to the classification of performance measures based on single, multiple, and composite criteria. In a study of dysfunctional consequences of performance measurements, Ridgway (1956) maintains that one of the major inadequacies of a single criterion, usually used by operations researchers, is the choice of proper criteria for performance measurement. As such, organizations seek to develop several criteria intended to focus attention on the many facets of a particular job. In the absence of a single overall composite measure of performance, individuals have to rely on their own judgement to decide which criteria will optimally improve the level of their performance. These judgements are in turn shaped by the individuals' conceptions of the hierarchy among the multiple criteria held by their superiors. As a result, organizations need to combine the measures of the various subgoals into a composite score for overall performance.

Since each measurement is faced with certain shortcomings, the choice among single, multiple, and composite measurements should be made in light of the risks involved in each. A single measurement ignores important goals and constraints. Multiple measurement systems enumerate goals, but may lead to an undue emphasis on a selected goal or subset of goals. Finally, composite measurements require explicit weighting of criteria, which are prone to shifts in goal hierarchies induced by environmental changes, or to the rejection by managers who may deem these weightings as irrelevant or inequitable (Rappaport, 1970).

Since the measurement of performance requires a clear understanding of the criteria used in the assessment, we also need to know what is involved in the development of success criteria. Nagle (1953) provides a four-step procedure for the development of criteria to measure the success of individuals, which can be applied to other purposeful systems.

1. *Definition of the Problem.* In what activities we are trying to determine success?
2. *Activity Analysis.* What are the goals of the activity? What standards of performance are required? What is the relative importance of various related behaviours?
3. *Definition of Success.* What elements of the activity differentiate a successful

individual from an unsuccessful one? What are the weights of these elements?

4. *Development of Sub-Criteria to Measure the Elements of Success.* What are, if any, the sub-criteria measures?

The crux of this approach is that one should first specify the purposes, goals, or objectives of the behaviour before asking why some individuals are successful and why others are not. In other words, the approach advocates focus on 'why' and 'how' aspects of success. The evaluator hence needs to analyze the purpose or goal of an activity, behaviour, etc., and then develop criteria to measure the attainment of the goal.

1.2.2. Performance Benchmark

The second dimension in our classification scheme relates to the benchmark by which success is assessed. In general, the performance of players or teams participating in different types of competitive sport is ultimately assessed on a *relative* basis. However, all or parts of some sports with uni-component or multi-component evaluation functions are assessed according to the *absolute* performance of the players against a pre-defined benchmark.

Drivers in the qualifying rounds of major car races enter the finals only if they beat a certain pre-specified, i.e., absolute, time limit. So do athletes participating in swimming, running, and skiing. It should be noted that even though the winners of these sports are selected based on their performance relative to the participating reference groups, their ultimate performance is judged against a pre-established absolute touchstone called the record. Obviously, records are not permanent and change over time.

Examples of other sports with uni-component evaluation functions that are judged on an absolute basis are weight-lifting, volleyball, racquetball, and tennis. Again, the winners of all these games are determined by their attainment of more points than the other contestant(s). In a similar vein, examples of sports with multi-component evaluation function, which are benchmarked on absolute basis, can be found in the preliminary parts of gymnastics, skating, and diving events.

It is worth noting that absolute benchmark is analogous to static goal, for the object ultimately attains a final condition with respect to time or space. In essence, the contestants compete not against each other, but against a fixed goal, which is exogenous to the game. As Rosenblueth and Wiener (1950, p. 314)) have remarked:

> *If it (the goal) is static and the behaviour sequence is successfully achieved the behaving object will reach a relationship with the goal specifiable in time or space. This relationship should be reached under a relatively wide variety of conditions.*

In contrast to absolute benchmark, the majority of sports are evaluated purely on relative basis. The winners of such field sports with uni-component evaluation function as hockey, football, basketball are chosen based on their performance against the other competing teams. Similarly, the final competition of sports with multi-component evaluation functions such as skating and diving, is judged according to the relative performance of the participants. This class of sports is akin to what Rosenblueth and Wiener (1950) refer to as purposive behaviour with a dynamic goal, i.e., a goal that changes with regard to time or space (p. 314): "If the goal is dynamic the object should tend to minimize an error in one or more of its relations to the goal." For example, take the case of hockey. The ultimate goal of both teams is to win the game. However, each team adopts a different objective, depending on the score at any given time: the laggard most probably tries to match, while the winning team tries to keep its lead. In these cases the ultimate goal is static and absolute. But the process within which the competition is conducted is based on a dynamic goal as the objects continually re-examine their choices based on the feed-back they receive from their surrounding.

1.2.3. Applications

The parallelism between *success* and *winning* allows identification of several germane streams of research. Although there are numerous pertinent themes and topics in the literature, for sake of brevity only the topics of auctions and bidding, tournaments, and elections will be discussed here. Attempts will be made to show how these real life events fit as purposive behaviour into the above assessment matrix.

Auctions and Competitive Bidding

Auctions and competitive bidding are similar in that the bidders try to maximize their expected return based on a certain payoff function. In auctions, the winner is the player with highest bid, while in competitive bidding the lowest bidder wins the contract. Competitive bids can be based on either uni-component or multi-component bid functions (Engelbrecht-Wiggans, 1980). While the former class of bids is usually awarded solely on monetary basis, the latter class of bids takes into account other non-monetary components such as delivery date and quality. Similarly, while most auctions are usually conducted on a monetary basis, there are instances where the auctioneer takes into account other considerations.

Auctions and competitive bids can almost invariably be assessed according to relative performance benchmark, provided the player bids lower (or higher in case of auctions) than a reservation price[3], if any. For example, if there is a reservation price then performance of the bidder is initially assessed against this requirement before the bid is allowed in the auction or bid.

It should be noted that the payoff function determines who gets what on the basis of the strategies chosen by the players (Engelbrecht-Wiggans, 1980). Almost all auctions and bids with single monetary bids are awarded to the highest (lowest) bidder. This is true even in bids with bonus pricing payoff functions. In this form of bids, which are used in most offshore oil lease auctions, the price is equal to the price plus a fraction of the value of the oil recovered. The actual price of the lease is not known until the completion of the exploration of the lease.

Yet in a variety of other types of auctions all players must pay an amount, whether or not they win or lose. In a discussion of wars and animal competition for territory or mates, Engelbrecht-Wiggans (1980, p. 123) maintains that in these situations:

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[3] Reservation price is the minimum (maximum) price acceptable to the auctioneer (granter of bid).

... The player expends progressively more time, energy, and other resources until it is clear which of the players is willing to go the furthest. Since the resources committed are not recoverable, such games are second price auctions in which all non-winners pay the maximum amount they were willing to bid.

This is similar to the way most competitive sports with relative performance benchmark are conducted. At the first glance, therefore, auctions and competitive bids exhibit the properties of a first-order predictive behaviour[4] in that the bidder tries to predict the positions of the other bidders vis-a-vis the target. But in the context of the concept of *purpose,* the final success of the contract ultimately depends on the degree of accuracy of the original bid as well. That is, winning a bid is only a sufficient condition for successful completion of a contract; the final success depends on how accurately the bidder has predicted the true value of the contract.

Tournaments

In recent years, economists, among others, have drawn parallels between tournaments and workers' reward structure. The premise of this body of literature is that in a series of tournaments and competitive lotteries among managers winners of the tournament at one level are allowed to enter the next tournament.

Lazear and Rosen (1981) maintain that three types of incentive payment schemes are used in practice: simple rates, standards, and tournaments. *Simple piece*

[4] The concept of predictive behaviour, as used in cybernetics, is somewhat restrictive because it requires "the discrimination of at least two coordinates, a temporal and at least one spatial axis" (Rosenblueth at al., 1943). Here, we have extended this definition to encompass the conventional meaning of the term, i.e., the ability to foretell.

rates and *standards* tie workers' compensation to their absolute output. In the former scheme, compensation is a linear function of output. In the latter scheme, performance is measured against a fixed standard. Employees' compensation is one of two fixed payments, depending on whether their output is above or below the specified standard.

In *tournaments*, on the other hand, earnings depend on the rank order of the contestants who forfeit some of their expected compensation in order to create a fixed number of prizes (O'Reilly III, 1987). Unlike the other two schemes, in tournaments performance incentives are set by employees' attempts to *win* the prize pool. In other words, employees compete against each other for one of two fixed prizes, allocated on the basis of the rank order of their output levels. Payment depends only on the rank of performance, and not on either the absolute level of performance or the size of the differences in performance across employees (Bull et al., 1987).

The tournament theory has also been applied to other types of rewards such as promotion. As Green and Stokey (1983) point out, since the hierarchical structure of the organization is usually fixed, employees at one echelon compete for a fixed, smaller number of positions at the next echelon. Elections can also be regarded as a form of tournament (Bull et al., 1987), since many candidates try to win a limited number of positions.

It can be shown that the three types of payment schemes, as well as promotions and elections, are all purposive behaviour, and therefore, teleological (Rosenblueth et al., 1943). The behaviour of the individual is controlled by the margin of error at which the individual stands at a given time with reference to a relatively specific goal. It can further be shown that incentive systems based on piece rates and standards exhibit the characteristics of non-predictive behaviour, in that the individuals simply *follow* a specified goal. In contrast, tournaments are characterized by predictive behaviour, because the individual should be able to extrapolate his or her path, as well as those of the other contestants, vis-a-vis the goal.

Concerning the evaluation function, the activities just described are measured by either uni-component criterion or multi-component criteria. For example, payment systems rely on a single criterion, i.e. output. On the other hand, promotions and elections are based on multi-component functions where individuals are assessed according to several evaluative measures.

2. INFORMATION SYSTEMS SUCCESS

The concept of information technology[5] is a *sine qua non* for the study of its success. For IT to be treated as a distinct form of technology, its salient characteristics and properties need to be clearly identified.

2.1. What is Information Technology?

> *IT is the set of non-human resources dedicated to the storage, processing and communication of information, and the way in which these resources are organized into a system capable of performing a set of tasks.*
>
> (Bakos, 1985, p. 20)

[5] IT is used as a generic term to designate different types of computer-based information systems.

Based on this definition, technology is treated as a structural variable, delineating various ways in which organizations manage their resources. And information is considered as a factor of production from a macroeconomic point of view, and as an input to the production process from a microeconomic perspective. In this context, IT is not differentiated from other process technologies in that information is considered to be like any other form of production input, and that technology is treated as a form of capital investment used to manipulate the input (i.e., information).

Bakos (1985) contends that the above traditional definition neglects an important, and often ignored, role of IT. He argues that the concept of bounded rationality is most applicable to IT because organizations, like human beings, have limits on their communication capacity.

> *IT encompasses systems that affect the bounds in the rationality of organizational units and the limitations of their information related process technology. These bounds and limitations may be either internally imposed (because of human neuro-physiological limitations) or external (because of technological design limitations).*
>
> (p. 20)

This new definition has a dual role. First, as before, information can be viewed as a factor of production. In this context, IT assumes its traditional role of a process technology, and hence is devoted to the utilization of resources related to the handling and processing of information. Second, information can be treated as a component of an organization's environment. In its role as an organization technology, then, IT can have significant impact on the bounds of organizational rationality. This second role of IT appears to have a more important relevance for designers and managers of IS. Individuals react to information about changes in the state of the world demonstrating a set of goals, and hence can use IT to extend their neurophysiological limits on memory, computational, and communication capabilities. Similarly, organizations are bounded by the complexity and size of problems they face, and can consequently use IT to raise these limiting boundaries.

Two principal dimensions of IT are specified as *functionality* and *capabilities* (Bakos, 1985). As can be seen in Figure 2.2, the pertinent attributes of the *functionality* dimension of IT are in turn described as *storage (1.1), processing (1.2),* and *communication (1.3).* These characteristics altogether allow a better understanding of the impact of IT on human and organization ability to handle information. It should be noted that different types of information systems possess all three characteristics. The goal of a particular type of system, however, influences the degree with which each characteristic is embodied in that class of system. Transaction processing systems, for example, are primarily concerned with the storage and processing of large quantities of information. The primary focus of MIS, DSS, and executive information systems, on the other hand, is on the communication of information. It should be apparent though that these types of systems all have varying degrees of storage and processing ability.

The attributes underlying the *capability* dimension are defined as *capacity (2.1), quality (2.2),* and *cost (2.3).* While capacity refers to the ability to handle large amount of information in a given time interval, quality is concerned with the ability to preserve the accuracy of information. Functionality and capabilities together determine the performance of a system. Cost, on the other hand, refers to efficient utilization of resources of alternative value: economic, social, or otherwise. The trade-off between cost and performance represents a technological frontier, which allows identification of the maximum performance achievable at a given cost (Bakos, 1985).

	Storage (1.1)	*Processing (1.2)*	*Communications (1.3)*
Capacity (2.1)			
Quality (2.2)			
Cost (2.3)			

Figure 2.2. Characterization of Information Technology

2.2. Information Systems Success: An Illustration

As a way of illustration, the case of a chess-playing system will be used to tie the preceding epistemological treatment of success to the basic properties of information systems. This illustration is intended to help explain what is meant by IS success and what criteria should be used in its evaluation.

It should be clear that a chess-playing system is coupled with both its environment and its goal. A change in the environment resulting from, say, other concurrent applications in the computer, will modify the behaviour of the system. Similarly, the system registers messages from its surroundings in order to couple with its goal, as it does in case of inputs from the player. The system, therefore, has choices in reaching a favourable end result in that it can take different courses of action based on its internal algorithm.

It should also be noted that the goal of the system is attainable. For example, given the rules of chess, the final condition for which the system strives is the beating of its opponents. Needless to say, the goal could change depending on the objectives of the agent to that of, say, teaching chess to school children. Moreover, success of the system is assessed differently by different people, as a novice would likely differ in his or her evaluation of the degree of success of the system from that of a chess master. So, the goal of the system is related to the goal of the human operating it.

It is further recognized that the assessment of success of the system could be based on either uni-component or multi-component evaluation functions, depending on the desired goal. In this example, if the objective is to beat opponents, then success is evaluated dichotomously as winning or losing. On the other hand, if the system is used as a tool for teaching chess, then there is a need for a multi-component function to assess its degree of success.

Finally, it is noted that the goal of the chess-playing system can be either static or dynamic, again depending on the desired end-result. For example, if the goal is to defeat the world chess champion, then it is possible for the system to reach a relationship with this goal specifiable in time. This type of situation appears to be more tenable for uni-component evaluation functions. In contrast, if the goal is to teach chess to school children of different ages in different countries, then the goal becomes dynamic. In these cases, as Rosenblueth and Wiener (1950) have pointed out, the system tends to minimize potential errors in its relations to the goal. The assessment of success, therefore, becomes more complex than the previous case as there is a need for a) a clear specification of what is meant by teaching effectiveness, and b) different multi-component evaluation functions to assess the degree of success of the system used by different age groups in different countries. It should be recognized that even in these cases it is still possible to evaluate the degree of success of the system, taking into account the specificities of the defined goal, which are in turn predicated on the attitudes and objectives of the users of the system.

2.3. A Conceptual Framework of Information Systems Success

In order to help understand the concept of IS success, there is a need for a framework that highlights the basic properties of a successful system. To this end, we take a deductive approach by ensuring that the conclusions pertaining to the requisite properties of IS success are drawn from the premises underlying the general concept of success.

Building on the classification of behaviour presented in Figure 2.1, the basic properties of successful objects displayed in Table 2.1, and the characterization of IT just discussed, we argue *a) that information systems are active purposeful objects with* *an existing and attainable goal,*[6] *and b) that IS success should be studied taking into account the basic properties of successful objects and the principal dimensions of IT.* Furthermore, by drawing on the parallelism between the concepts of purpose and success, we maintain that the technical specificities of a system are tangential to the study of IS success. As Rosenblueth and Wiener (1950, p. 323) have pointed out:

> *If the term purpose is to have any significance in science, it must be recognizable from the nature of the act, not from the study of or from any speculation on the structure and nature of the acting object.*

In order to better comprehend the nature of an information system outcome, we need to employ the constituents underlying the basic dimensions of IS. The characterization of IT presented previously facilitates the operationalization of pertinent variables.

As can be seen in the conceptual framework of IS success presented in Figure 2.3, *users' requirements (F4)* dictate the system's goals, which in turn determine the functional requirements of the system in terms of storage, processing, and transmitting information. It should be noted that cost represents an efficiency measure of economic performance of the system. From an economic perspective, an organization is viewed as an economic artifact engaged in production processes, and IS is treated as process technology concerned with the utilization of resources. In this context, then, the cost associated with the adoption and maintenance of a system is often a parameter indicating how well resources are being utilized to achieve the

[6] This condition is added to circumvent the difficulty cited by Taylor (1950a), i.e., the problem of a system that is purposive, but there does not exist an object or feature in the environment with respect to which the behaving object can attain a final condition.

performance benchmarks for which the system has been designed.[7] In this light, we combine the three functional requirements (storage, processing, communications) and the cost of the system to represent *system's characteristics (F1).*

In addition to system's characteristics, *quality (F2)* of information produced in terms of resistance to errors (Bakos, 1985) also influences the success of the system.

Finally, the success of a system is influenced by organizational *outcomes (F3)* of the system. As will be shown in the next section of the chapter, the existing measures of IS success, by and large, have ignored the impact of the system on organizational outcome variables such as improved customer relation, sales, etc.

In light of the above discussion, IS success is then defined as *the correspondence between the domain of the stated goals and the system's outcomes, taking into account system's characteristics and quality of information produced.*

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[7] Bakos (1985) defines the other attribute of system capability, capacity, as the ability to handle large amounts of information in a given time interval. In our model we have combined this attribute with the attributes of system's characteristics.

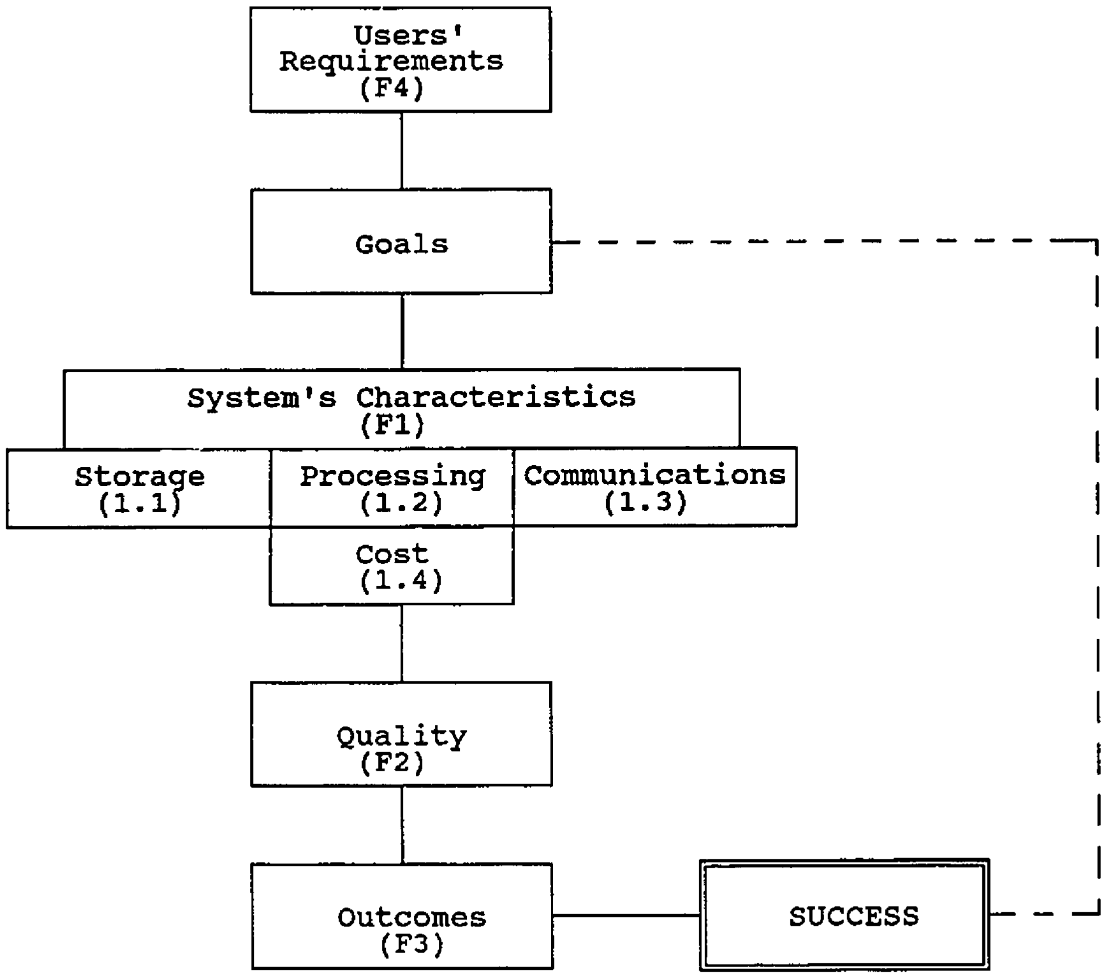


Figure 2.3. A Conceptual Framework of Information Systems Success

In Chapter 5, we will further elaborate on variables constituting different constructs in the above model. We will show that in order to measure IS success, we need to account for variables related to the following factors:

Factor 1. System's characteristics (F1)

Factor 2. Quality (F2)

Factor 3. Outcomes (F3)

Factor 4. Users' requirements (F4).

2.4. Methodological Considerations

Further to our previous discussion of the concept of success, it is contended that research on information system's success is similar to research on organizational effectiveness. In both cases, the objective of the researcher is to measure the degree of correspondence between the goals and the outcomes.

The concept of organizational effectiveness itself is inherently paradoxical, as organizations need to balance multiple and sometimes conflicting objectives (Weber, 1987). Despite this paradox, however, organizations learn to survive by balancing different objectives. Since organizational theorists have long examined issues related to effectiveness, attempts are made to employ the relevant literature on organizational effectiveness in order to gain further insight into both conceptual and methodological issues related to IS success.

Goodman et al. (1983) have identified four major problems related to studies of organizational effectiveness: 1) inadequacy in identifying indicators of effectiveness, 2) over-reliance on single indicators of effectiveness, 3) disregard for the time frame of the criterion variable, and 4) over-generalization to dissimilar organizations. Similarly, Cameron and Whetten (1983) have discussed several problems of assessing organizational effectiveness including: 1) the fact that the construct space of effectiveness has never been bounded, 2) the fact that effectiveness is a product of individual values and preferences, and 3) the fact that all relevant criteria of effectiveness have never been identified.

More recently, Cameron (1986) has contended that the foregoing problems are primarily of concern to researchers and not of managers and lay public, who make judgements about organizational effectiveness regardless of the criteria available to them. In these situations, when primary indicators of effectiveness are not readily apparent, secondary or easily accessible indicators are substituted. The problem of course is that the rationale for the judgement may have little or no relationship to organizational performance. Researchers, on the other hand, have to grapple with some critical issues when assessing effectiveness of organizations. In particular, they must struggle to identify indicators that can be measured reliably and validly, and that have some theoretical utility.

In a longitudinal study of colleges and universities, Cameron (1986) developed an instrument consisting of items identified in interviews with respondents as indicating organizational effectiveness. In order to reduce the likelihood that the respondents purposely bias their evaluations in a positive direction, they were asked to *describe*, rather than *evaluate*, certain characteristics possessed by their institution. Cameron identified both the major dimensions of organizational effectiveness and its predictors. In addition, by computing the differences between effectiveness scores at two points in time, he identified what factors account for changes in effectiveness over time.

Change, however, is an elusive concept. Golembiewski et al. (1976) outline three types of change: alpha, beta, and gamma.[8] These changes are relevant to the

[8] *Alpha Change* involves a variation in the level of some existential state, given a constantly calibrated measuring instrument related to a constant conceptual domain. *Beta Change* involves a variation in the level of some existential state, complicated by the fact that some intervals of the

study of IS success as they allow not only the identification of factors effecting changes over time, but also the sources of these changes.

In order to limit the scope of effectiveness assessment, Cameron (1980) has outlined six critical questions. Dickson et al. (1988) and Davis and Hamann (1988) have applied these questions to IS assessment and provided examples of how to address them, a summary of which is shown in Table 2.2.

Table 2.2. Critical Questions in Assessing IS Effectiveness

	Critical Questions	Examples
1.	What domain of activities is being focused on?	Internal activities versus external activities; Single IS versus IS function in an organization.
2.	Whose perspective, or which constituency's point of view, is being considered?	Internal constituencies versus external constituencies.
3.	What level of analysis is being employed?	Individual effectiveness, subunit effectiveness, or organizational effectiveness.
4.	What time frame is being employed?	Short-time perspective versus long-term perspective.
5.	What type of data is being used?	Perceptual versus objective; Observations, interviews, surveys.
6.	What referent is being employed?	Normative - relative to a theoretical idea; Comparative - relative to a competitor; Goal-centred - relative to stated goal; Improvement - relative to past performance; Trait - relative to effective traits.

measurement continuum associated with a constant conceptual domain have been recalibrated. *Gamma Change* involves a redefinition or reconceptualization of some domain, a major change in the perspective or frame of reference within which phenomena are perceived and classified.

Using these guidelines, it can be seen that a precise demarcation of the domain of the assessment will facilitate the operationalization of the pertinent variables in the conceptual framework of IS success. In the process, we also need to decide whether the assessment of IS should be based on a uni-component or a multi-component evaluation function. To this end, the following four guidelines are suggested to limit the scope of the assessment of IS success, taking into account the basic properties of IS success and the above critical questions.

First, in the assessment process, attempts must be made to see *whether the system has attained its pre-specified goal.* This goal can be either static or dynamic, depending on the type of the system. Take the example of a payroll system, which is designed to produce a certain number of cheques of certain specifications in a given period of time. As long as these initial fixed goals are achieved, the system is successful. Assume that a firm using this system has outgrown it. In this case, the system is successful so long as it attains its original goal of producing cheques of certain quality for the predefined number of employees. Now assume that the original goal of the system had been to satisfy all the payroll requirements of the firm in long run. If the system is not capable of coupling with this dynamic goal at any point in time, it is then deemed to have failed. It should be pointed out that implicit in this guideline is that the notion of success is relative and changes over time, and that the system is coupled with the goal as well as the environment.

Second, in line with the second basic property of successful IS, we need to delineate the domain of analysis so that it is clear *for what the system is designed,* *and whose perspective is of primary interest.* The notion of purpose, we have seen, relies on the attitudes and objectives of the observer. It is conceivable then that a user deems a system successful given one objective but not another. Similarly, a system may be considered successful by a certain constituent but not by another. It should be recognized that the involvement of various constituents in the assessment process is more crucial in cases that are based on multi-component than on a uni-component evaluation function, because the assessment tends to rely more heavily on the perceptual judgments of the constituents.

Third, in accordance with the third basic property of successful IS, the assessment of IS success should be based on a *specific time frame and repetitive observations* so that the time perspective is known and random coincidences are eliminated. This guideline is congruent with the suggestions of a) Churchman and Ackoff (1950), who maintained that the study of purpose should be conducted relative to a period of time, and b) Rosenblueth and Wiener (1950, p. 324), who pointed out that the temporal observation is necessary "... to ascertain that the particular relation between the acting object and the constituents of the system interpreted as goal was not reached by the independent development of processes which fall in phase at a given moment."

Finally, we need to determine *whether the assessment should be based on a uni-component or a multi-component evaluation function.* A brief examination of the popular taxonomies of computer-based information systems (CBIS) reveals an interesting pattern in which these systems have over the years been developed, implemented, and evaluated. Systems targeted at operational activities of the firm are often based on uni-component evaluation functions. The scope of assessment of transaction processing systems, for example, is usually limited because a) the boundaries of the targeted activities are known, b) the constituency for which these systems are designed for are easily identifiable, and c) the attainment of their pre-specified goals is usually easily measurable. In contrast, the assessment of systems related to tactical and strategic activities of the firm tends to rely more heavily on multi-component evaluation functions as it is difficult to circumscribe the targeted domain of these systems.

In brief, it is maintained that *the assessment of IS success should be carried out using the summative approach in that it is the attainment of the pre-specified goal of a system that is the primary requisite of its success.* Moreover, it is recognized that IS assessment is a complex task and therefore requires a careful circumscription of the construct of IS success in order to diminish some of the conceptual and definitional ambiguities. Specifically, in the process of IS assessment it must be clearly understood *a) whose perspective is being considered, b) what level of analysis is being employed, c) what time frame is being employed, and d) what type of data are being sought.* As will be discussed in the next chapter, a major problem with MIS research in the area of assessment of IS success has been a rather narrow focus on various characteristics of the system's functionality. These studies, by and large, have not concentrated on the ultimate outcome variables representing the success of the system, i.e., attainment of goals in light of the basic properties of success.

3. REVIEW OF LITERATURE

The study of IS success can be traced back to the seminal work of Mason and Mitroff (1973) who maintained that examination of IS performance should focus on psychological type, type of problem, organizational context, and mode of presentation. Since then, numerous studies have concentrated on the evaluation of IS success.

This section provides a critical examination of this body of literature. First, major issues surrounding the measurement of IS success are discussed. In particular, the preceding epistemological coverage of IS success is used to challenge the assumptions underlying the outcome variables used in this area. Second, problems and difficulties surrounding the existing measurement instruments are discussed. Several guidelines are presented in order to address some of the related methodological problems.

3.1. Measurement of Information Systems Success

One of the first studies related to the operationalization of the benefits of computer systems was performed by Knutsen and Nolan (1974). They suggested six classes of benefits: 1) equipment replacement, 2) reduction of personnel, 3) increased operational efficiency, 4) increased sales, 5) better managerial planning and control, and 6) other organizational impacts. Building on this work, Ginzberg (1979) introduced a taxonomy of nine types of benefits. The first class of benefits related to the mandate of the system. Of the remaining eight classes of benefits, five resulted from changes in organizational processes while the other three ensued from changes to the information produced. Ginzberg's taxonomy of classes of benefits of IS is provided in Table 2.3.

Ginzberg argues that the ultimate impact of the system is realized through changes in organizational outcome variables such as sales, revenue, customer satisfaction, and profit contribution. These changes do not follow directly and immediately from the system. They result from changes in organizational processes, which are in turn affected by changes to information produced. In other words, benefits resulting from changes in various attributes of information produced would lead to certain changes in organizational processes, which would ultimately affect one or more organizational outcome variables.

This coverage of IS benefits partially captures the constructs of our conceptual model of IS success presented in Figure 2.3. Organizational outcomes correspond to the outcome factor in the model, organizational processes capture the cost and user characteristics, while information characteristics correspond to system quality.

Table 2.3. A Taxonomy of IS Benefits

Organizational Processes	Information characteristics
Improved planning processes	More timely information
Increased organizational flexibility	Newer, more, and better information
Improved organizational learning	Greater accuracy in clerical operations
Improved asset utilization and resource control	
Reduced information processing costs	

Recent studies in the area of IS assessment have extended Ginzberg's work. Zmud (1983, p. 340) maintains that the ultimate aim of an IS is to enhance both organizational performance and the quality of work life. The targets for performance objectives, in turn, might be elements of the system itself, the organization, or the organization's environment. It should be noted that a single IS can have as its objectives all three targets.

An IS may be developed to improve the efficiency of an existing system in terms of throughput, response time, etc. These types of systems, we have seen, are assessed in light of the three functionality characteristics of IS, which act as antecedent variables to the capacity characteristics, and not outcome variables. Therefore, the utilization of system-related elements as performance indicators has provided a partial representation of the system's success.

More commonly, the objective of an IS is to improve functioning of the organization. Internally, the benefits of a system may result in enhanced operations, improved planning and control capabilities, improved employee attitudes, better use of assets and resources, and increased sales or service capacity.

Externally, the objectives of a system may include improved relationship with customers, suppliers, stakeholders, or regulatory bodies. A popular methodology to evaluate the effect which IS has on a firm's external environment is the value chain analysis (Porter, 1985), which highlights the critical areas where a firm can improve its relationship with its customers and suppliers or change the basis of the competition. Specifically, developments in information technologies are expected to give rise to three sets of effects on interorganizational relations: a) reducing costs of communication while expanding the reach, b) increasing the number and quality of considerations of alternatives, and c) increasing the degree of independence between the set of participants involved in a network (Malone et al., 1987).

In light of these performance objectives, Zmud (1983) classifies the benefits of a system into four broad classes of measurable performance indicators:

i. *Financial indicators*, such as cost reduction, sales, or market share,

ii. *Organizational functioning indicators*, such as service time or customer satisfaction,

iii. *Personnel indicators*, such as employee satisfaction or morale,

iv. *System indicators*, such as response time, flexibility, or accuracy.

Although this classification divides the benefits of a system into a logical scheme, some comments should be made regarding the interrelationship between these indicators. As was displayed in the conceptual framework of IS success, the hierarchical order between various elements of IS success calls for an examination of the interactions between the system's goal, its functional requirements, and its resulting performance. The assessment of the system's success may therefore require a balance of multiple and sometimes conflicting objectives (Weber, 1987). However, researchers in the area have by and large focused on only one of these indicators as a proxy for IS success. This has in turn resulted in the measurement of outcome variables, which at best provide a partial picture of the system's success.

In the following sections, we will discuss in more detail various conceptual and methodological problems surrounding the three popular outcome variables of IS success used in the literature.

3.1.1. Economic Benefits

The first class of studies in IS success uses various forms of input-output analysis to relate IS inputs to such economic benefits as profits and growth. These studies are predicated on the principle that costs of IS should be measured against the financial benefits expected or enjoyed through improved process. More recently, transaction cost economics has been proposed to evaluate the impact of IT (Malone et al., 1986), but difficulties associated with measurement and computation have impeded research progress in this area (Ciborra, 1987).

Crowston and Treacy (1986) have argued that in order to gain an insight into the organizational impacts of IS, it is necessary to understand how internal support systems contribute to enterprise level performance; i.e., how the information system impacts competition and corporate performance. They subsequently provide a list of related articles published from 1975 to 1985. An examination of this work and associated research published after 1985 reveals that these studies either employ cost-benefit analysis or various other methodologies and definitions of performance drawn from economics. However, cost-benefit analysis accounts for qualitative benefits by attributing to them some quantitative value, treating them as a side issue, or ignoring them altogether (Keen, 1975).

Similarly, studies based on economic analysis need to measure the firm's inputs and outputs, but there is no consensus as to what these should be and how to measure them. For example, in examining the basis for IT investment, Weill and Olson (1989) suggest a combination of measures in order to understand the impacts of IT investment on different aspects of performance. To this end, they suggest that measures should be logically tied to the performance objective of each type of IT. A firm's revenue growth rate is suggested as a measure of effectiveness of strategic IT investment; return on assets is proposed as a measure of those IT investments that are aimed at improving management decision making; and change in non-production labour is suggested to measure transactional IT investment. Other performance measures recommended in the literature include market share (PIMS, 1984) and the ratio of net operating income to total asset base (Turner, 1985).

By relying on economic benefits of a system, this stream of research has focused on only one of the three dimensions of a system's capability: cost, thus ignoring the role that the quality and capacity dimensions may play in attaining the system's goals. A system's success, should be assessed in light of its performance, which is a function of all these three dimensions. By concentrating on only the cost factor, it is not clear whether the system has been able to process the required information in a given time interval, or whether the accuracy of the information has been preserved. In other words, since the tradeoff between cost and performance is disregarded, it is difficult to see how well resources have been utilized to attain the system's performance benchmarks.

3.1.2. Usage

Usage as a surrogate measure of IS success is employed in numerous studies (e.g., Robey, 1979; Schewe, 1976; Srinivasan, 1985). Ginzberg (1978) questioned the usefulness of usage because a) it cannot be used in situations where usage is mandatory, and b) it ignores the importance or value of individual tasks. Problems related to various types of usage and the extent to which obtained information is actually used further complicate this construct (Miller, 1989).

In their survey of the literature, Trice and Treacy (1988) have also identified the major problems in the utilization literature. First, they maintain that there is a lack of accumulation of knowledge in the area, partly because of the lack of any standardized measure. As a result, research methodology rather than theory has driven the choice of utilization measure. Second, they point to researchers' preference for reported utilization over more accurate unobtrusive measures because a) it is more difficult to obtain machine usage statistics, and b) utilization data is usually collected in a *post hoc* manner. Trice and Treacy argue that in light of the absence of any articulated theory, it is possible that utilization acts as an intervening variable between information technology and performance. On the one hand, it is partially determined by IT variables; on the other, it is one of the variables that ultimately affect performance. It should be noted that a few studies (Robey, 1979; Schewe, 1976; Srinivasan, 1985) which have attempted to examine the link between satisfaction and usage (as a surrogate measure of success) have found inconclusive evidence regarding correlation between these two measures.

More recently, in a comprehensive survey of approximately 3000 accounting professionals, Pentland (1989) examined the relationship between use and productivity in personal computing. Usage was measured based on self-reported levels of use. Efficiency was evaluated both objectively, as the difference in the time required to complete an auditing case when a personal computer is used, and subjectively, as self-reported time spent on the case. Effectiveness was assessed using both objective measures (dollars assessed per hour of time on case) and subjective measures (five-point Likert scale capturing the difference in the quality of work done using the computer).

Pentland (1989) found low association between use and overall efficiency and effectiveness. Based on this finding, he warns researchers against the treatment of usage as a proxy for IS success in the absence of actual productivity measures.

3.1.3. User Perceptions

A growing number of MIS studies have relied on users' perceptions in order to measure the success of IS. These studies suggest that users' attitudes can be used as a surrogate for usage, quality, value and other system attributes. The proponents of this approach contrast *scientific* with *management* measurement, asserting that measurement for management decisions must be pragmatic and teleological, and must emphasize the users and their responses to the measure rather than the object measured (Mason and Swanson, 1979). Perceptual measures appear to fulfil these requirements, i.e., measures related to user perceptions of a system are said to influence subsequent usage and realized value to the organization.

User information satisfaction (UIS) is the most widely-used perceptual measure in the literature. Miller (1989) provides a summary of these studies. Several major conceptual problems related to this construct, however, remain to be resolved. First, UIS has been employed to evaluate system success, yet the link between these two constructs is not anchored in any articulated theory. Specifically, the attitude construct has become virtually synonymous with a particular operationalization of it, i.e., UIS (Ives et al., 1983). In addition, the definition of IS success has focused only on *affective* measures, ignoring *output-oriented* measures such as benefits derived from the system (Melone, 1990). Second, the effect of temporal changes on users' attitudes has not been accounted for, i.e., it is not clear how users form attitudes towards technologies and how these attitudes are changed over time. Third, attitudes have been treated from a historical rather than a prospective perspective, making it difficult to predict *a priori* users' responses before the introduction of a system (Melone, 1990).

In brief, our review of the literature reveals three fundamental difficulties facing studies that have used the above three outcome variables. As a result, this work has not been a profitable direction to pursue because it has, by and large, ignored the very principles guiding the assessment of IS success. First, implicit in these research studies is that individual variables measure a system's success irrespective of the goals for which the system have been designed. This clearly violates the definition of IS success: the correspondence between the domain of the stated goals and the system's capabilities. Second, the other two basic properties of successful systems have received either cursory attention or have been disregarded completely. Specifically, the roles of time and the observer's attitude and objectives in the assessment of a system's success have not been explored. Third, from a methodological viewpoint, there is no solid argument as to what type of evaluation function would best capture the essence of IS success. General wisdom advocates the use of composite measures (e.g., Weber, 1987). However, in the absence of any grounded theory, we still do not know why one type of measure is better than the others. Nor do we know whether there is any relationship between single, multiple, and composite measures of IS success.

Information systems are used by various stakeholders in a variety of contexts. The assessment of a system's success, therefore, is influenced by the divergence of the stakeholders' attitude and objectives, as well as the diversity of contexts within which information systems are employed. In light of the first difficulty mentioned above, a set of measures needs to be developed that encompasses pertinent items related to all four measurable performance indicators - financial, organizational functioning, personnel, and system. Since we know little about the relationships between these performance indicators and a system's success, it is instructive to incorporate various measures used as surrogates of IS success into an all-encompassing measurement instrument. By including items that would capture the degree of attainment of all potential goals of a system, then, we will be able to assess the extent of a system's success. This approach will facilitate the examination of the covariation between the observed variables. We will also be able to study whether the success of different types of systems shares a common structural model.[1] This would contribute to the development of articulated theories that a) identify factors underlying IS success, and b) explain the relationships among these factors.

The other two difficulties mentioned above relate to methodological issues, and will be addressed in the following section.

3.2. Measurement Instruments

Success of IS, we have seen, is captured either through objective output-oriented measures or through perceptual measures. The former class of studies attempts to identify the benefits of the system. However, there are no accepted methods to measure them, nor is there a consensus as to what these benefits are (Crowston and Treacy, 1986; Kauffmann and Weill, 1989).

The perceptual measures of IS success, on the other hand, have been developed and employed extensively over the last 15 years. These measurement instruments have basically relied on UIS as a surrogate measure of IS success. Table 2.4 shows a summary of these instruments and the studies that have used them. The most widely used measure is the instrument developed by Bailey and Pearson (1983). A 22-item version and a 13-item version of this instrument were later developed by Ives et al. (1983) and Baroudi & Orlikowski (1986), respectively. Miller and Doyle (1987) and Doll and Torkzadeh (1988) also derived items from the Bailey and Pearson instrument to develop specific instruments.

The usefulness of UIS instruments has been attenuated because of two major problems. First, the distinction between cognitive aspects (beliefs about characteristics of a system) and affective aspects (attitudes towards a system or towards using a system) has been blurry. This confusion has in turn introduced additional bias or random error into measurements (Goodhue, 1988). Conceptually, it is important to determine which construct - belief or attitude - best captures the full meaning of IS success. For example, if the goal of a system is its acceptance by the users based on their beliefs about the functionality of the system, then beliefs should be measured. On the other hand, if the assessment is predicated on the premise that the introduction of a system effects changes in the workplace, and that the success of the system is related to the positive feelings of the users about these changes, then attitudes should be measured. Given our previous definition of IS success, and in light of the pertinent organizational theories such as job satisfaction (Iaffaldano and Muchinski, 1985), it appears that the success of a system can best be measured through assessing the users' attitudes toward a system in terms of attaining its pre-specified goals. Second, the existing perceptual instruments have limited their scope to cognitive and/or affective dimensions, thus ignoring the importance of output-oriented components of systems. It is clear that the goal of a system may potentially include objectives that go beyond affective dimensions, and therefore the assessment of IS success should encompass items that represent these non-affective dimensions.

Table 2.4. User Information Satisfaction Measurement Instruments

Instrument	Coverage	Items	Scales	Dimensions	Subjects	Related Studies*
Gallagher (1974)	IS Product	18	Beliefs	Perceived $ value of report	75 mangers	
Schultz & Slevin (1975)	OR Implementation	67	Beliefs & Attitudes	Probability of success Probability of use by others Probability of use by resp't Worth of the system Level of accuracy	136 MBA students	Robey & Zeller (1978) Robey (1979)
Jenkins & Ricketts (1979)	IS Product	5	Beliefs	Report content Report form Problem solving Input procedure Systems stability	197 students	Srinivasan (1985)
Larcker & Lessig (1980)	IS Product	2	Beliefs	Perceived importance Perceived usableness	29 students	
Alloway & Quillard (1981)	IS Product & Function	26	Beliefs			Miller & Doyle (1987)
Bailey & Pearson (1983)	IS Product & Support	39	Beliefs & Attitudes	39 factors	29 managers	Baroudi et al. (1983) Mahmood & Becker (1985) Reymond (1985) Baroudi & Orlikowski (1986) Miller & Doyle (1987) Reymond (1987) Barones & Louis (1988) Montazemi (1988) Tait & Vessey (1988)
Ives, Olson & Baroudi (1983)	IS Product & Support	22	Beliefs & Attitudes	EDP Staff and Services Information Product Vendor support Involvement	280 managers	

* These studies have used some or all items of corresponding instruments.

Table 2.4. User Information Satisfaction Measurement Instruments (Cont'd)

Instrument	Coverage	Items	Scales	Dimensions	Subjects	Related Studies*
Sanders (1983)	IS Product	13	Beliefs & Attitudes	Overall satisfaction Decision-making satisfaction	378 managers	Sanders & Courtney (1986)
Baroudi & Orlikowski (1986)	IS Product & Support	13	Attitudes			
Miller & Doyle (1987)	IS Product & Function	37	Beliefs	Characteristics of IS User participation Strategic issues Responsiveness to change End user computing IS staff quality	276 managers	Miller (1988) Miller (1989)
Guimaraes & Gupta (1988)	MIS Department	19	Beliefs & Attitudes		109 top managers	
Doll & Torkzadeh (1988)	End-User Computing	12	Beliefs	Content Accuracy Format Ease of use Timeliness	618 user managers	

* These studies have used some or all items of corresponding instruments.

In summary, several guidelines have been suggested in order to circumvent some of the difficulties surrounding the three outcome variables of IS success (Lucas, 1989, p. 403; Kauffmann and Weill, 1989):

1. Development of reliable performance measures, taking into account the locus of value and employing a set of measures rather than unitary measures.
2. Use of cross-sectional data to simulate a time-series by including in the data set firms that have or have not invested in a specific technology and then examining whether a specific impact has occurred in both cases.
3. Comparison of inter-group responses to the questionnaire containing the measurement items in order to better understand the role of different stakeholders.
4. Development of roughly comparable questionnaires to assess the success of different types of system, and then keep track of user reactions over time.
5. Consideration of the moderating effect of organization context factors in the relationship between IT investment and firm performance, in particular that of those related to top management commitment to IT, organization experience with IT, satisfaction with IT, and the extent of political turbulence within the organization.

By implementing these guidelines in our research methodology, several advantages will ensue. First, we will enhance our understanding of the interrelationship between various variables used as proxy for IS success by employing a set of measures. For example, by correlating each of the multiple measures (e.g., UIS) with a global single-item measure of success.

Second, we can examine the effects of temporal context (Hawgood and Land, 1988; Venkatraman and Zaheer, 1989; Melone, 1990), by comparing historical data of firms who have invested in a particular type of IS with prospective data of firms who have not. The inter-group cross-sectional data of firms that have or have not invested in a specific technology can be used to study the changes in informational base of the decision makers. The results will in turn allow identification of sources which have contributed to the attitude changes of respondents in the two groups. This will ultimately facilitate the development of *a priori* theories to predict the likely effects of a particular type of technology on organizational performance before the introduction of that technology.

Third, we will be able to identify the principal factors underlying IS success by comparing perceptions of different groups of stakeholders about success of different types of systems. This will allow mapping of the basic structure of the system, which is independent of users and technologies, as well as the surface structure of the system, which encompasses those aspects of the system that depend on users or technologies (Weber, 1987).

4. SUMMARY

Implicit in IS assessment research is that CBIS change the way individuals, units, and organizations achieve their objectives. Researchers' challenge then is to identify and measure such changes, focusing on the constituency and the type of the system that is being assessed, the time frame of the study, and the efficacy of different types of evaluation functions used in the assessment process. These objectives can best be achieved by a) providing a precise operational definition of IS success, b) developing valid and reliable measuring instruments, c) continually recalibrating the measuring instruments, and d) redefining the conceptual domain of the construct.

Since none of the existing categories of outcome variables of IS success sufficiently captures its full meaning, the next step is to a) develop and adopt valid and reliable measuring instruments, b) employ research methods that could address the pertinent conceptual and methodological difficulties. In this light, we first explicated the meaning of IS success by identifying its basic properties. Then, we developed a conceptual framework of IS success, and discussed some of the relevant methodological issues. Reviewing the literature, we concluded that MIS researchers have, by and large, treated the concept of IS success cursorily, concentrating on outcome variables that at their best provide a partial picture of IS success.

In order to deal with this problem, we proposed a set of guidelines. Specifically, we advocated the use of multiple measures of IS success. This approach is believed to a) enhance our understanding of the efficacy of different evaluation functions, and b) uncover some of the difficulties related to the interrelationship among some of the surrogate measures of IS success.

At an operational level, we suggested an investigation of the effect of temporal context by comparing data of firms that have or have not invested in a particular information technology. At a theoretical level, we identified the basic properties of successful systems, which in turn explain inherent behaviour of such systems. In addition, we believe that the empirical results of this study will help the development of *a priori* theories capable of predicting the effects of particular types of information technology on individual and organizational performance.

In the next two chapters, we will provide the theoretical groundwork necessary for testing the first two major research hypotheses. In Chapter 3, we will show that IS success is composed of a) generic properties shared by all successful systems, and b) properties that are specific to a particular type of systems. In Chapter 4, we will examine the dynamic role that time plays in the IS adoption and assessment process. Major sources of bias that affect the decision maker's informational base will be identified. The implications of these time-related changes for evaluation of IS success will be explored.

CHAPTER 3 - AN EXAMINATION OF THE CONCEPT OF SUCCESS: INTERNAL VERSUS EXTERNAL INFORMATION SYSTEMS

This chapter challenges the first assumption outlined in Chapter 1, focusing on the concept of success as it relates to internal versus external information systems. Specifically, highlighting the common basic properties as well as the distinct and inherent characteristics of these two classes of systems, the theoretical groundwork in support of the following hypothesis is laid out:

> *H1:* *The success of external and internal information systems shares certain structural properties.*

Building on our earlier coverage of success and taking a top-down approach, it is argued that the behaviour of successful systems is influenced by a universe of properties common to all successful systems, at one extreme, and by a set of properties specific to each type of system, at the other.

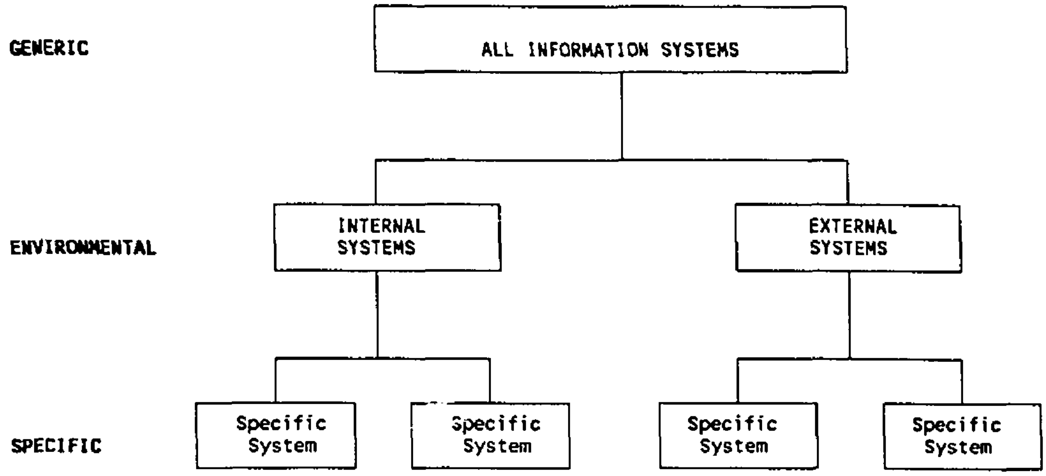
The primary objective of the chapter is to identify the specific properties of successful internal and external systems, as well as the factors common to both classes of systems. It starts with a hierarchical model of IS success, which divides the properties of successful information systems into three groups - generic, environmental (internal versus external), and specific. Using this model as a general framework, IS success at all three levels is then discussed. Specifically, generic properties of successful IS are identified, inherent characteristics of internal and external systems are outlined, and several specific types of systems are reviewed. The interplay between these three levels of properties is used to highlight the specific properties constituting the success of internal and external IS.

1. A HIERARCHICAL MODEL OF IS SUCCESS

Ives et al. (1980) developed a research framework for MIS research dividing an information system into five parts: a) the IS subsystem itself, b) the development, operations, and use processes, c) the development, operations, and user environments, d) the organization environment, and e) the external environment. In this framework, the dimension demarcating the line between internal and external systems is the external environment. Using this taxonomy as a guideline, it can be argued that variables associated with the external environment are the principal factors, which affect the structural composition of the construct of success as applied to external systems. In other words, since the success of both internal and external systems are affected one way or the other by variables pertaining to all other parts of the framework, variables related to the external environment act as discriminating factors influencing the structural model or pattern of loadings of the constructs of success as applied to external systems.

In this light and in view of our coverage of successful systems in Chapter 2, we present the pyramid structure of IS shown in Figure 3.1. Specifically, we maintain that the success of information systems is composed of three components: a) properties shared by all IS, b) properties shared only by internal or external systems, and c) properties unique to specific systems.

Figure 3.1. A Hierarchical Model of Information Systems



The top level of the model covers the basic properties of all successful information systems. The intermediate level focuses on the unique properties that differentiate successful internal systems from the external ones. Finally, the bottom level relates to properties of specific types of successful systems, internal or external.

2. SUCCESS OF IS: GENERIC PROPERTIES

In Chapter 2, we identified three generic properties of successful IS: goal-orientation, attitude-dependence, and time-dependence. At an operational level, we argued that the underlying characteristics of the functionality dimension of an IS act as antecedent variables to its capacity and quality, which in turn determine the system's performance. In other words, we maintained that the performance of a system is a function of a) the system's *capacity*, that is the ability to achieve certain performance benchmarks in terms of storing, processing, and transmitting information in a given time interval, and b) the system's *quality*, that is the ability to preserve the accuracy of information. Further, we stated that the other constituent of the capability dimension, *cost*, represents an efficiency measure of economic performance of the system. Therefore, the outcome variable of the system's success, we contended, must be studied in light of the constituents underlying its capability, i.e., capacity, quality, and cost.

We also identified three popular outcome variables of IS used in the literature: economic benefits, usage, and perceptual measures. We maintained that each of these categories captures a partial picture of IS success, because different systems are designed with different goals in mind, and to be used by different stakeholders within different organizational contexts. We attributed this shortcoming to the surface structure (Weber, 1987) of the system, which encompasses those aspects that depend on users, contexts or technologies. In addition, we argued that successful information systems exhibit a basic structure, which is independent of these parameters.

A close survey of the pertinent literature reveals that over the years the concept of information, its basic dimensions, and its perceived usefulness and value, have received a great deal of interest from researchers in various disciplines. To shed more light on the common properties of successful information systems, we will proceed with a review of some of these studies.

Swanson (1974) attempted to operationalize the concept of MIS value. Using a semantic differential scale, he identified 16 items constituting what he referred to as MIS appreciation. Although this work is one of the very first in the area, it also suffers from serious conceptual as well as methodological problems. No measures of reliability of the scale are reported, nor has there been any attempt to test the validity of the constructs under the study.

Gallagher (1974) used the semantic differential technique to measure the value of a MIS. He identified four major dimensions of the concept of MIS value:

I. Quantity - complete, sufficient

II. Reliability - true, reliable, valid, accurate

III. Quality format - readable, orderly, logical, clear, simple

IV. Timeliness - current, timely

In a study of operations research/management science models and techniques, Schultz and Slevin (1975) developed an instrument to measure implementation success. A total of 67 items yielded the following seven dimensions:

I. Effect of model on manager's job performance

II. Interpersonal relations

III. Changes resulting from the model

IV. Goal achievement and congruence

V. Support for the model/lack of resistance

VI. Client/researcher interface

VII. Urgency of results

Correlating these factors with several dependent variables such as probability of use, probability of success, and the worth of the model under study, Schultz and Slevin identified performance, goals, support, and urgency as the most important factors. It should be recognized that in spite of its contribution in explicating the concept of success, the use of this instrument is somewhat constrained due to several conceptual and methodological issues such as the lack of construct validity and low ratio of sample size to items.

Zmud (1979) later used these dimensions and the items comprising them to empirically derive the dimensionality of the concept of information. The eight derived dimensions formed the following structure:

I. Quality of information

Relevant - applicable, helpful, needed, significant, useful

II. Relevancy components

Accurate - accurate, believable

Factual - factual, true

Quantity - complete, effective, material, sufficient

Reliable/Timely - current, reliable, timely, valid

III. Quality of format

Arrangement - orderly, precise

Readable - clear, convenient, readable, simple

IV. Quality of meaning

Reasonable - logical, sensible

Larcker and Lessig (1980), questioned the utility of the above instruments because of unreported psychometric properties. Subsequently, relying on the previous literature on MIS and accounting, and taking into account psychometric considerations associated with the construction of a measurement device, Larcker and Lessig developed a new instrument to measure the perceived usefulness of information. The two main dimensions were labelled *perceived importance*, which is related to whether information is adequate, sufficient, and essential, and *perceived usableness*, which is related to whether the information is simple, correct, and interpretable.

In a study of the relationships between quality of information and decision makers' use of information, O'Reilly (1982) factor analyzed 18 items. He identified two principal factors comprising information quality. The first factor, labelled *quality of information,* included seven items: two items reflecting the accuracy of information, three items representing the relevance and specificity, one the reliability, and one the timeliness. This factor accounted for 70% of variance, with a Cronbach alpha of 89%. The other factor, labelled *ease and accessibility of information,* included three items. This factor accounted for 17% of variance, with a Cronbach alpha of 94%.

More recently, Davis (1989) developed and validated new scales for two specific variables, perceived usefulness and perceived ease of use. Perceived usefulness was defined as the extent to which an application contributes to the enhancement of the user's performance, and ease of use related to the effort required by the user to take advantage of the application. Reviewing the literature, Davis selected 14 items to represent each construct. Employing appropriate psychometric techniques resulted in a 6-item scale representing the construct of usefulness. These items related to the use of a particular application in terms of i) accomplishing the user's tasks more quickly, ii) improving the user's job performance, iii) increasing the user's productivity, iv) enhancing the user's job effectiveness, and v) making the user's job easier. The last item related to the usefulness of the application in the user's job. It is noteworthy that although Davis applied these instruments to four different applications[1] at two different time periods, he found excellent psychometric characteristics for them. Specifically, he found significant correlations between usefulness and usage for all four types of applications at both time periods, indicating that perceived usefulness acts as a direct determinant of system usage and that it shares basic structural properties for all successful systems.

Based on this review of the literature we identify four major generic factors that are shared by all successful information systems: i) output characteristics, ii) system's characteristics, iii) system's outcomes, and iv) user characteristics. The structural models representing these factors are introduced in Chapter 5. The items used to measure the factors, along with the empirical findings related to the hypothesis that the construct of IS success shares a common structural model for all types of systems are listed in Chapter 6.

In Chapter 2 we defined IS success as the correspondence between the domain of the stated goals and the system's outcomes, taking into account the system's characteristics, quality, and cost. These attributes, then, seem to make up the basic structure of successful IS, as they represent the underlying factors that have been incorporated in the design and implementation of all successful systems. The

[1] An electronic mail, a file editor, and two graphics systems.

surface structure of successful systems, on the other hand, is determined by the environmental constraints and users' requirements, which in turn dictate the system's goals. The surface structure of a successful system, then, depends, among other things, on the goals for which the system has been designed, the users, and the context within which the system is used. Applying this to the pyramid structure of IS success, we notice that since all successful systems exhibit a common structural model, the factors differentiating successful internal and external systems should relate to their surface structures.

3. SUCCESS OF INTERNAL IS

In this section, pertinent literature is reviewed in order to highlight the properties of several specific types of successful internal IS. First, a definition of success as applied to internal systems is presented. Next, several types of internal systems are reviewed in order to identify specific factors constituting the success of these systems.

3.1. Definition

An information system has traditionally been defined as (Davis and Olson, 1985, p. 6) "an integrated user-machine system for providing information to support operations, management, and decision making functions in an organization." It follows, then, that internal systems are designed and implemented to support internal aspects of operations, management and decision making functions in the firm. The unit of analysis in the related studies is the firm itself, as internal systems do not involve inter-corporate linkage with suppliers, distributors, customers, competitors, or any other external agencies. Strictly speaking, then, the principal factor separating internal systems from external ones is the electronic linkage between the firm, its competitors or one or more of the constituencies in its value system (Porter, 1987).

Internal systems encompass almost all classes of systems in the popular taxonomies of information systems (e.g., Scott Morton and Gorry, 1971), including transaction processing systems, management information systems, decision support systems, and executive support systems. In addition to these, systems used by different classes of stakeholders (e.g., end-user computing), or in different organizational contexts (e.g., small business) have also been studied as internal systems.

In this light, the success of an internal system may be defined as *the degree of goal attainment in terms of supporting* internal *operations, management, and decision making functions in an organization.*

3.2 Some Examples of Specific Internal IS

The literature related to the success of several types of internal IS is examined in order to highlight the specific as well as generic factors constituting success of these systems. Specifically, success of decision support systems (DSS) is used to stress the importance of the *type* of the system. Similarly, the role of *stakeholders* in the success evaluation process is examined through a survey of end-user computing research. Yet the role of organizational *context* in the success assessment process is examined by reviewing the literature on small business systems.

3.2.1. Decision Support Systems

A large number of studies have examined the issues surrounding evaluation of DSS. Success in these studies has been assessed using numerous performance measures, including quality of decision (Joyer and Tunstall, 1970; King and Rodriguez, 1977; Aldag and Power, 1986), decision time (Benbasat and Schroeder, 1977; Benbasat and Dexter, 1982; Goslar et al., 1986; Sharda et al., 1988), rate of decision improvement (McIntyre, 1982), number of alternatives (Eckel, 1983; Cats-Baril and Huber, 1987; Sharda et al., 1988), and decision-making and user satisfaction (Barki and Huff, 1985; Mahmood and Medewitz, 1985; Sanders and Courtney, 1985).

As can be observed, the effectiveness of a DSS is measured via a large number of surrogate variables measuring a change in decision making performance. This is congruent with the definition of success of internal systems, as the focus is on the degree of goal attainment in terms of supporting decision making function in the organization. The specific properties making up the success of DSS are related to the improvement of decision quality. On the other hand, the generic properties of successful DSS, as a special type of internal system, are captured using popular measuring instruments such as the UIS scale.

3.2.2. End-user Computing

The success of end-user computing is difficult to assess because, as Kleinberg (1986) has noted, these computing systems by their very nature defy central control. Among the problems associated with microcomputers are security, data integrity, incompatibilities, data recoverability, application controls and audit trails, acquisition and use, and costs. Because of the diversity of these problems, however, the assessment of microcomputer-based systems has proven to be a difficult task. A reduction in MIS applications backlog is said to be one way in which firms can measure the success of these types of systems (Leitheiser and Wetherbe, 1986). Nonetheless, isolating the effects of end-user computing on the overall computing utility of the firm has been very difficult, if not impossible.

One of the first studies in the area was done by Rivard and Huff (1988), who used a single-item scale of overall user satisfaction as a measure of success of end-user developed applications. More recently, Doll and Torkzadeh (1988) developed an instrument to measure end-user computing satisfaction. The basic premise underlying this instrument is that end users assume more responsibility for their own applications, and therefore their satisfaction should be measured differently from that of users of conventional computing environments. Doll and Torkzadeh found that apart from one factor - ease of use - the items in the other four major factors representing end-user computing satisfaction are very similar to the items developed by Ives et al. (1983). This finding further supports our previous argument that the success of any type of IS is made up of some generic as well as specific factors.

3.2.3. Small Business Systems

The importance of organizational context factors in the evaluation of systems has repeatedly been emphasized in the literature (e.g., Ein-dor and Segev, 1978). One of these contextual factors that has attracted a great deal of interest in recent years is the size of the organization under study. The contextual differences between small and large organizations are due to three types of specificities. First, the small organization is typically characterized by a simple, highly centralized structure (Mintzberg, 1979). Therefore, the success of IS in this context is influenced by organizational specificity. Second, the success of small business systems is influenced by decisional specificity because the strategic decision cycle or time frame of small businesses is different from those of large businesses (Mintzberg, 1973). Third, since owner-managers of small business firms play a dominant role in terms of decision-making and psychological climate within their organization (Miller et al., 1982), the success of small business systems is affected by psycho-sociological specificity (Raymond, 1990).

Studies examining the determinants of IS success in small business have employed three types of surrogate measures to capture the essence of the dependent variable: a) a modified version of Bailey and Pearson's user information satisfaction instrument (Lees, 1987; Montazemi, 1988; Raymond, 1985), b) computer usage (Delone, 1988; Lees, 1987), and c) the impact that the computer applications have on business, as measured by the sum of the products of the application importance score and the application success score (Delone, 1988). These measures are respectively similar to the perceptual, usage, and economic measures used to calibrate the success of IS in the context of large business.

The major difficulty with this stream of research is that the factors representing the above three dimensions of specificity of small business have not been clearly isolated. A natural starting point seems to be the identification of items representing these specific dimensions. A combination of factors incorporating these and other generic factors would provide a more accurate measures of IS success in the small business context.

In sum, the above illustrations highlight the role of surface structure in the IS success assessment process. At the environment level, we noticed that the parameter differentiating internal systems from external ones is related to the specificity of the internal environment, as the domain of analysis is constrained by the internal operations, management and decision-making functions of the organization. At a more micro level, the surface structure of a system is influenced by several specific factors such as the type of the system and its stakeholders, which dictate the system's goals, and the organizational context, which focuses on various situational specificities within which the system is designed and used.

4. SUCCESS OF INTERORGANIZATIONAL SYSTEMS (IOS)

This section focuses on the concept of success as applied to external IS. First, successful IOS is defined. Next, through a review of the existing literature, specific factors making up the success of these systems are identified. Finally, the specificities of IOS success are employed in order to lay out the major properties differentiating successful internal systems from external ones.

4.1. Definition

> The inter-company computer-to-computer communication of standard business transactions in a standard format that permits the receiver to perform the intended transaction.
>
> (Sokol, 1989, p. 12)

It should be noted that EDI is not electronic transmission of data in a free form. Therefore, it excludes facsimile transmission, which requires rekeying of data by the receiving party, and electronic mail, which requires rekeying or editing of data. However, it includes tape exchange of business documents in an EDI related format.

Although we have seen a surge in the use of EDI in recent years, EDI has been under active development for almost three decades. The early systems were proprietary and used by large companies in different sectors, notably car manufacturing, retailing, and transportation. A large majority of EDI systems today, however, are based on widely accepted standards, such as American National Standards Institute's X.12, which is used throughout North America, and the United Nations' EDIFACT, primarily used in Europe.

What makes EDI distinctively different from other types of interorganizational systems is that EDI allows trading companies to conduct business using standard business transactions, thus eliminating rekeying of the transmitted data. In addition, EDI improves not only inter-corporate relations, but intra-organizational functionings as well. As EDI is being integrated into the internal information systems of the organization, it will become the driving force behind the automation of the entire business transaction cycle, including the order processing cycle, the production cycle, and the payment cycle.

At a more general level, external systems are concerned with electronic linkage between a firm and its external constituencies. Johnston and Vitale (1988) present a framework to guide the search for opportunities created by IOS. They classify these systems according to the business purpose, the relationships between the sponsoring organization and the other participants, and the information function of the system. Johnston and Vitale then highlight the potential sources of competitive advantage, using the causal model of competitive advantage presented by Bakos and Treacy (1986). It is argued that competitive advantage is stemmed by either bargaining power or comparative efficiency. Bargaining power is affected by search-related costs, unique product features, and switching costs. Comparative efficiency, on the other hand, is achieved by improving internal efficiency and interorganizational efficiency.

As discussed in the conceptual framework of IS success presented in Chapter 2, the environmental constraints and users' requirements dictate the system's goals, which in turn determine the functional requirements of that system. The attributes of the related functionality characteristics subsequently influence the system's performance. In this light, and in view of our preceding discussion of external systems, the success of an external system may be defined as *the degree of goal attainment in terms of improving the bargaining power with trading partner(s) or comparative efficiency of an organization.*

4.2. Review of Literature

IOS are recognized as natural extensions of interorganizational relations because they facilitate exchange of information and resources among the participating firms. In this section, first a brief review of the literature on transaction costs economics is provided to explain why electronic linkages are formed. This is followed by a survey of the literature on interorganizational relations highlighting the structural dimensions of interorganizational systems. Finally, pertinent research on IOS is examined in order to identify the specific factors constituting the surface structure of these systems.

4.2.1. Formation of Electronic Linkage

The transaction cost approach to the study of economic organization regards the transaction as the basic unit of analysis. Production costs include the physical processes necessary to create and distribute goods or services. Transaction costs (coordination costs), on the other hand, include information processing costs associated with the coordination of the work of people and machines that perform the primary processes. Transaction costs are said to be the economic equivalent of friction in physical systems. Their absence can be related to some of the unrealistic assumptions in economic analyses (Williamson, 1981; Williamson, 1985, p. 19).

Williamson (1985) has identified three critical dimensions for describing contractual transactions: a) uncertainty, b) the frequency with which transactions recur, and c) asset specificity. Asset specificity refers to the degree to which an input is specific to a given firm. An input that is highly specific to a firm cannot readily be used by other firms. At least three different types of asset specificity are identified: a) site specificity, as when successive stations are located near each other to economize on inventory and transportation costs; b) physical specificity, as in a machine designed for a specific single purpose; and c) human asset specificity that arises in a learning-by-doing fashion. In addition to these three types of specificity, the importance of time specificity is recognized in the context of strategic use of IT. Johnston and Carrico (1988) maintain that this factor is responsible for the development of systems that allow firms to sell products and services that have high market value prior to some period.

It is recognized that economies have two basic mechanisms (markets and hierarchies) for coordinating the flow of material and services through adjacent steps in the value-added chain (Williamson, 1975). Markets coordinate the flow through supply and demand forces and external transactions among firms, while hierarchies coordinate the flow by controlling and directing it at a higher managerial level. In markets, a buyer compares and selects an input based on its different attributes. Production costs are minimized because there are numerous suppliers to choose from, while coordination costs are relatively high because of costs associated with gathering and analyzing market information. In hierarchies, on the other hand, buyers work with a single predetermined supplier. Production costs are high because the procurer's choice of supplier is limited to one, while coordination costs are generally low because there is little need for gathering and analyzing information related to different suppliers.

Malone et al. (1987), in a coverage of electronic markets and electronic hierarchies, assert that because of the decreasing cost of IT coordination costs are reduced, thus leading to an overall shift toward proportionately more use of markets than hierarchies. Two general arguments in support of this proposition are provided. First, it is posited that markets have certain advantages over hierarchies as a means of coordinating economic activities and that their main disadvantage is the cost of conducting the transactions themselves, i.e., coordination costs. Second, through the use of information technology, the degree of complexity associated with product descriptions can been reduced. Some product descriptions previously classified as highly complex, such as airline reservations, can now be treated as low in complexity because information technology has facilitated description of the product. At the same time, information technology has entailed a reduction in the asset specificity of some products. In particular, the physical specificity of some products has been reduced through flexible manufacturing technology where it is possible to change over the production lines from one product to another.

The transaction costs approach provides a rational economic explanation for the proliferation of interorganizational information systems. As Mansfield (1968) has noted, economic development is spurred by economic necessity, and economic structure dictates the level of technology adoption. Accordingly, it is reasonable to assume that the real or perceived economic justification acts as a primary driving force in the adoption process of the interorganizational systems. In light of the scarcity of theoretical background in the area of information systems evaluation (Ahituv, 1980), the perceived economic justification of the IOS appears to play a more important role in the adoption process than its real economic realization.

4.2.2. Structural Dimensions of Interorganizational Systems

The majority of work in the area of interorganizational relations (IR) is based on the population ecology model (Hanan and Freeman, 1977, p. 36; Aldrich, 1979, pp. 267-291). This approach emphasizes adaptive fitness and regards the competition for resources as the driving force behind organizational change. The major perspectives that organizations take into account in their relations with other organization are a) resources and services exchanged, and b) the dependence resulting from such relations. The former perspective relates to voluntary activities (exchanges) between two organizations that bring about the realization of their goals (Levine and White, 1961). No reference to relationships involving coercion or domination is made. The latter perspective, on the other hand, goes beyond the idea of simple exchange, treating interorganizational relationship as a political phenomenon. In this context, one consequence of sharing resources is believed to be the development of domination of one organization and the dependency of another one (Aldrich, 1979, p. 267).

In order to analyze and monitor IR, Marrett (1971) focused on the structure of the linkage between organizations. She identified formalization, standardization, intensity, and reciprocity as the four major dimensions along which the structure may be analyzed. Van de Ven (1976) later expanded the work of Marrett (1971) and developed a social action system that adopts a structure and process for organizing activities between two or more organizations. In addition to structural dimensions, Van de Ven outlined the process dimensions, situational factors, and outcome dimensions of IR. The process dimensions include flows of resources and information between organizations involved in an inter-agency relationship. The situational factors required for the formation and maintenance of an interorganizational relation are identified as: a) resource dependence, b) perceived commitment to resolve environmental needs or realize opportunities, c) knowledge of these needs and opportunities, d) consensus about solutions to environmental needs and opportunities, and e) domain similarity. Finally, outcome dimensions of an interorganizational relation are captured in the perceived effectiveness of the system, which can be measured by the extent to which agencies carry out commitments and believe relationships are worthwhile, equitable, productive, and satisfying.

4.2.3. Interorganizational Information Systems

Barrett and Konsynski (1982) were among the first to conduct a major academic work in the area of IOS. They defined five levels of participation for individual firms within an IOS based on the purpose of the system. Barrett (1985) extended this work by outlining the potential benefits of an IOS as cost reduction, cost displacement through downloading data entry tasks, productivity improvements such as discount taking and improvement in inventory handling and strategic advantage through channel analysis and the formalization of participant relationships.

Similar to internal systems, IOS can also be divided into different classes. A popular taxonomy of these systems has been their division along the line of constituency for which the system has been designed. It could be argued that since each group of stakeholders possesses certain specific characteristics, then the surface structure of the success of the corresponding system is also influenced by specificities surrounding that particular group. For example, Runge (1985) focused on customer-based strategic systems (COSS) and examined the enabling factors that influence the success of these systems. He used the rate of adoption of the system by the customers as the dependent variable. Horner Reich and Benbasat (1990) expanded Runge's work by focusing on factors influencing the development and factors influencing the adoption of COSS. They measured the success in three ways: a) timely development of the system, b) successful adoption by the customers, and c) improvement in the competitive position of the firm. They identified several factors enabling companies to be first-movers in developing COSS. These factors related to the characteristics of the firm and industry as well as those associated with the IS function and the development project.

More recently, Hansen and Hill (1989) reported the results of a survey of 1094 firms using EDI. The rating of various EDI benefits on a 5-point scale were found to be: i) improved customer services, ii) improved control of data, iii) reduced clerical error, iv) decreased administrative cost, v) decreased inventory cost, vi) increased sales, and vii) decreased manufacturing cost. It is noted that EDI is a special type of IOS, using functions rather than stakeholders as the differentiating parameter. As stated earlier, EDI is concerned with improving the inter-corporate transactions, regardless of the constituency it serves. Therefore, similar to some internal systems such as DSS, its surface structure depends on the functions it performs, which are in turn a byproduct of the original goals of the systems.

IOS should be studied in light of the specificities of interorganizational relations. These include structural dimensions such as intensity and reciprocity, as well as outcome dimensions such as the perceived effectiveness of the systems in terms of making the interorganizational relation more equitable and productive.

5. SUMMARY

In this chapter we have proposed that the success of information systems is composed of two basic types of properties: a) those generic properties that are shared by all successful systems, and b) those that are specific to a particular type or class of IS. Based on this premise, we divided IS into two broad categories of internal and external systems. It was shown that the principal factor demarcating the domain of these two classes of IS encompasses variables related to the external environment of the organization. The success of external IS, we maintained, is differentiated from that of their internal counterparts due to the structural differences between these two classes of systems. Specifically, we stated that while internal systems are adopted to support internal operations, management, and decision making in the organization, external systems are implemented to improve the bargaining power or comparative efficiency of the firm. In spite of these differences caused by the specificities of surface structure, we contended that all IS also share a deep structure, whose dimensions are influenced by the three functionality characteristics of the systems - capacity, quality, and cost.

One the major problems surrounding IS success literature has been the inability of researchers to isolate the factors constituting the basic structure of successful IS from those comprising their surface structure. We believe that the theoretical groundwork laid out in this chapter, coupled with the subsequent empirical examination of the hypothesized commonalities between the structural models of internal and external systems, will solidify the existing theories related to the assessment of the success of information systems.

The success of information systems is also dependent on time. In the next chapter, we will focus on this variable to show how the decision maker's attitudes are changed in various stages of stages of the IS adoption decision process.

CHAPTER 4 - THE ROLE OF TIME IN THE EVALUATION OF INFORMATION SYSTEMS SUCCESS

In the previous chapter, we identified the first simplifying assumption underlying MIS research as the treatment of the firm as a stand-alone unit. In addition, we maintained that research on IS success has been predicated on the assumption that time is an invariant rather than a variable construct. Specifically, we stated that almost all empirical studies in the area have been conducted retrospectively, thus ignoring the effect of temporal setting or its correlates on the decision maker's judgement and perceptions. Even though the literature on cognitive psychology and organizational behaviour has pointed to a large number of sources of bias which could affect the human information processing cycle (see Hogarth and Makridakis, 1981; O'Reilly, 1983), to our knowledge, no MIS study has examined whether the decision maker's attitude toward the success of an information system changes during various stages of the adoption process. As a result, our picture of the IT assessment process has primarily been based on the outcomes of the adopted system, without taking into account the effect of temporal setting or other sources of bias. If these biases do exist, then the use of the existing measuring instruments should be limited to the ex-post evaluation of IS success.

This chapter relies on the literature on psychology, organizational behaviour, and diffusion of innovation to develop a theoretical groundwork for the following hypothesis:

H2: The decision maker's perception of IS success changes during various stages of the adoption process.

We will postulate that by defining and measuring IS success retrospectively, MIS research has ignored the dynamic nature of the adoption and assessment process. We will subsequently argue that the utility of the existing measures of IS success is limited because these measures, at best, provide a snapshot of the degree of success of a system only at the end of a system's development cycle.

The chapter starts with a review of the innovation literature highlighting the specificities of various stages involved in the adoption of new technology. Then, pertinent research on psychology and organizational behaviour will be examined to gain a better understanding of the determinants of attitudes, the process of attitude formation, and the factors effecting attitude change. Special attention will be given to the linkage between various stages of the adoption process and attitude formation and change. In addition, germane literature will be reviewed to investigate several aspects of temporal orientation of individuals and their effects on information acquisition and use. Next, a list of major sources of bias that affect a decision maker's informational base is provided. Finally, various issues related to measurement of change are discussed.

1. A MODEL OF INFORMATION SYSTEMS ADOPTION PROCESS

> Diffusion is the process by which 1) an *innovation* is communicated 2) through certain *channels* 3) *over time* 4) among the members of a *social system* (Rogers, 1983, p. 10).

An innovation is characterized by the decision maker's uncertainty about the expected consequences of the innovation, on the one hand, and an opportunity for uncertainty reduction caused by the efficacy of the innovation in solving a felt need or perceived problem, on the other. Two kinds of information are used to handle these uncertainties (*ibid*, p.14):

"1. *Software information*, which is embodied in the technology and serves to reduce uncertainty about cause-effect relationships involved in achieving a desired outcome.

2. *Innovation-evaluation information*, which is the reduction in uncertainty about an innovation's expected consequences."

Rogers (pp. 163-186) presents a five-stage model, which focuses on the individual adopter's decision process and reflects the general decision model presented by Simon (1977). This model sheds some light on a process consisting of a series of actions and choices over time through which an individual or organization assesses the viability of a new idea. The stages involved in the innovation adoption decision process are as follows:

1. Knowledge	relates to a decision maker's exposure to the existence of an innovation.
2. Persuasion	refers to the subsequent formation of attitudes toward that innovation.
3. Choice	involves the decision maker's choice to adopt or reject the innovation. Until this stage, the decision process has been a strictly mental exercise.
4. Implementation	involves overt behaviour change and occurs when the decision maker puts an innovation into use.

5. Confirmation — occurs when the decision maker seeks reinforcement of the innovation decision already made. Throughout this stage the individual tries to avoid a state of cognitive dissonance or to reduce it if it occurs.

Some researchers (Coleman et al., 1966, p. 59) argue that individuals play a passive role during the knowledge stage, while others contend that the predisposition of individuals influences their behaviour toward communications messages. In the latter case, the decision makers go through *selective exposure* in order to avoid messages that are in conflict with their predisposition, or to attend to messages that are consistent with their existing attitudes and beliefs. Innovation messages have little or no effect unless the innovation characteristics are consistent with the decision maker's *selective perception*, which is the tendency to interpret communication messages in terms of one's existing attitudes and beliefs (Rogers, 1983, p. 166).

During the knowledge stage, the individual mainly searches for software information that is embodied in the innovation. If the information is deemed relevant, then the individual considers the persuasion stage, at which point the decision maker increasingly seeks innovation-evaluation information in order to reduce uncertainty about the expected outcomes of the innovation. Using primarily interpersonal networks, the decision maker searches evaluative information about the advantages and disadvantages of the innovation. In other words, the decision maker's mental activity changes from a cognitive type to an affective type, as he/she becomes more psychologically involved with the innovation. Selective perception then becomes significantly important, as the individual's general perceptions of the attributes of an innovation are formed at this stage. Through a vicarious process, the decision maker becomes involved in a forward planning in which the new idea is mentally applied to present and future situations before trying it. The ultimate outcome of this stage is the formation of a favourable or an unfavourable attitude towards the innovation.

This formation of attitude subsequently leads to a decision to adopt or reject the innovation. Up to the implementation stage, the decision maker has gone through a strictly mental exercise. Implementing an innovation, however, entails an overt behaviour change. The individual actively searches for information in order to reduce uncertainty associated with the consequences of the innovation. This stage may last for a long time, until the innovation is routinized.

Finally, at the confirmation stage, the individual seeks to reduce or eliminate dissonance by changing his/her knowledge, attitude, or action. However, since changing one's decision to adopt an innovation usually entails large investments, the decision maker normally avoids dissonance by seeking only that information that supports the decisions that have already been made. This is done by either selective exposure, selective perception, or selective forgetting of dissonant information.

Earlier we noted that at the persuasion stage, the decision maker develops general perception of the innovation. In order to predict the rate of adoption, we need a standard classification scheme for describing these perceived attributes of innovations. Tornatzky and Klein (1982), in a meta-analysis of seventy-five articles, found three innovation attributes to have the most consistently significant relationships to innovation adoption. These attributes were identified as a) compatibility, b) relative advantage, and c) complexity.

Compatibility relates to the degree to which an innovation is perceived as being consistent with the existing values, past experience, and needs of the receivers. Two aspects of this attribute are technical compatibility and organizational fit, such as adopter's attitude and perceptions regarding change. This attribute is found to have a positive relationship to adoption (Ettlie and Vellenga, 1979). *Relative advantage* refers to the degree to which an innovation is perceived as being better than the idea it supersedes. This attribute is also found to have positive relationship to adoption. *Complexity* relates to the degree to which an innovation is perceived as relatively difficult to understand and use. This attribute is found to have a negative relationship to adoption. Although a large number of other attributes have been cited in the literature as being related to technological innovations, Tornatzky and Klein (1982) did not find consistent results regarding the direction of association of these variables with organizational innovative behaviour.

Since the above three characteristics of innovation are based on the perceptions of individuals involved in the adoption decision process, they should be operationalized in light of the confines of perceptions and attitudes measurement. A pertinent theoretical foundation for the study of the relationship between beliefs, attitudes, and behaviour is the theory of reasoned action (Fishbein and Ajzen, 1975). According to this model, beliefs represent information about an object by linking an object to some attribute. Attitudes, on the other hand, are formed based on a person's favourable or unfavourable evaluation of some attributes related to that object. It follows that attitude change involves changing a person's beliefs, whether they are beliefs about the object or beliefs about its attributes. As shown in the model of adoption decision, an adopter forms a certain attitude toward the outcomes of adopting that innovation during the persuasion stage and the confirmation stage. During the persuasion stage, a favourable attitude would lead to a behavioral intention, which could subsequently lead to an overt adoption behaviour by the decision maker. At this level, one's attitude toward adopting an innovation is a function of one's beliefs about the outcomes of actually adopting. This is in contrast to the diffusion theory that states that the acceptance of an innovation is related to general characteristics of the innovation as perceived by the potential adopters (Moore, 1987). In order to reconcile this apparent discrepancy between these two theories, it is maintained that a direct link could be made between the perceived characteristics of an innovation and the potential outcomes of the innovation by treating the former as the precursor of the latter construct. Stated differently, one's beliefs about the characteristics of an innovation would serve as the change agent in altering one's beliefs about the outcomes of that innovation. In this context, it can be argued that the success of an innovation as perceived by the adopter, i.e., a favourable attitude toward the outcomes of the innovation, depends, among other things, on the perceived characteristics of the innovation itself.

In addition to the persuasion stage, attitude formation takes place in the confirmation stage of the adoption decision process when the adopters re-evaluate their attitude toward the innovation depending upon the correspondence between their prior expectations and the actual outcomes of the innovation. Potential changes could be anticipated if the total informational base underlying the attitude (Fishbein and Ajzen, 1975, p. 400) were altered in the period between the persuasion and confirmation stages.

In order to better understand the role of time in the decision maker's attitude formation/confirmation regarding an information system's success, we present a model of information systems adoption and assessment process. As can be seen in Figure 4.1, the model encompasses a cyclical process that continually brings in unison the original outcomes expected from a system and its actual outcomes. The characteristics of the three stages of the model are briefly described below, focusing on the role that time plays in influencing the decision maker's attitude towards the success of the adopted system.

Stage 1. Formation

Rogers (1983, p.98) maintains that the question of why organizations adopt innovations has seldom been investigated by diffusion researchers. He suggests that a better understanding of why an innovation is adopted would heighten our knowledge of the innovation adoption process.

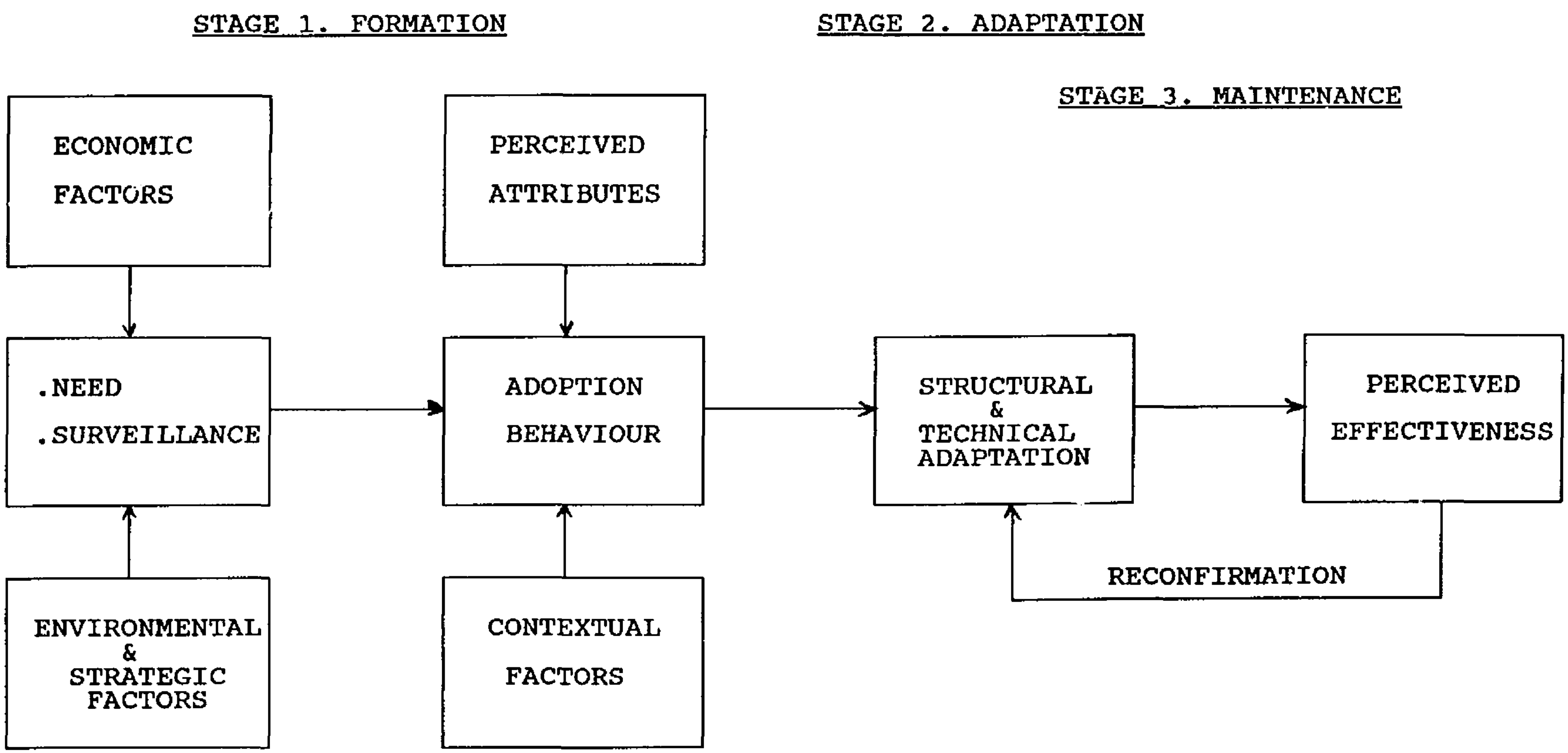
The first stage of our model is predicated on the tenet that the formation of IT is primarily influenced a) by the perceived economic justification of the adoption, b) by the environmental and strategic forces, c) by the perceived attributes of the system, and d) by the organizational context in which the adoption is taking place. The decision process involved in this stage corresponds to the first three stages of the diffusion of innovations model, and is strictly a mental exercise predominated by the perceived characteristics and the expected outcomes of the system.

The perceived potential of an IT influences an organization's expectations about the outcomes of the system, which in turn affect the decision makers' attitudes toward adopting that system. These attitudes are then translated into behavioral intentions, which are ultimately changed to overt behaviour to adopt or reject the system (Fishbein and Ajzen, 1975). Two sets of factors are of particular importance in this process of attitude formation: a) the perceived attributes of the system and b) the organization context in which the adoption process is taking place. The role of the specific characteristics of the system has repeatedly been acknowledged in the innovations literature, while the significance of the contextual variables to the adoption process has been recognized in MIS and organization theory.

Stage 2. Adaptation

The adaptation stage of the research model in Figure 4.1 corresponds to the implementation stage of the innovations model, and is characterized by overt behaviour change of the adopting firms. Having decided to develop or adopt a technology, organizations need to make two types of adaptation. First, they must make technical adaptation in order to integrate the system into their overall information systems network. Second, the participating firms must make structural adjustments in order to conform to the organizational changes effected by the system.

Figure 4.1. A Conceptual Model of Information Systems Adoption and Assessment Process



Stage 3. Pattern Maintenance

The final stage of the model relates to the pattern maintenance of the adopted system. It corresponds to the confirmation stage of the diffusion of innovations model, and like the formation stage, it involves forming and/or confirming attitudes. Throughout this stage, the decision makers try to evaluate the success of the system. In cases where there is a discrepancy between the original effects expected from the system and the actual economic, organizational, and behavioral outcomes of the systems, efforts are made to minimize the ensuing dissonance. Consequently, either the adopted system is modified to accommodate the organization's needs and structure more closely, or the structure of the organization may have to be changed to accommodate the adopted system (Rogers, 1983, p.185).

Schein (1970, p. 120) presented an adaptive-coping cycle, emphasizing the importance of feedback in the study of organizational adaptation to its internal and external environments. Similarly, the feedback loop in our model focuses on the interplay between the adaptation stage and the pattern maintenance stage, with the primary purpose of guiding and controlling the actual performance of the adopted system. As Katz and Kahn (1966, p. 416) have pointed out, organizations seek feedback from both internal and external environments. The internal feedback is concerned with either the technical side of internal functioning or the social side. The external feedback, on the other hand, can be from the reception of the organization's product by the clientele or market. Obviously, this latter form of feedback has particular relevance to the assessment of success of IOS.

Attitude formation and change, we have seen, occur at various stages of the innovation adoption process. In the next section, we will provide explanations from the literature as to why attitudes are changed over time, what roles various information processing biases play in the change process, and what methodological issues should be accounted for in the measurement of change.

2. ATTITUDE CHANGE OVER TIME

Organizational theorists have traditionally paid little attention to the concept of time. More recently, however, a wide variety of temporal topics have attracted students of organizational research. Specifically, the role of time in several areas of organizational research, such as strategic planning, decision making, and group behaviour, has gained popularity in recent years (McGrath and Rotchford, 1983; Bluedorn and Denhardt, 1988).

It has been concluded that people hold different perceptions of time, and that perception of time biases their other perceptions one way or the other. In a study of the role of perception of time in consumer research, Graham (1981) outlines three basic perception models: linear-separable, circular-traditional, and procedural-traditional. In the *linear-separable model*, time is perceived as linear (past, present, future) and separable into discrete compartments. This European-American perception of time treats activities as means to ends, the attainment of which lies somewhere in the future. The *circular-traditional model* regards time as a circular system in which events are repeated according to some cyclical pattern. This perception is common among cultures where actions are not regulated by the clock. Through its heavy present orientation, people do not have a feeling that they can affect the future. In the *procedural-traditional model*, activities are procedure driven rather than time driven. This model is also present-oriented, and people who follow it focus on a procedure without regard for time.

Throughout this dissertation, we assume a linear-separable model of time perception used in the American-European cultures, envisioning time as a road that stretches from the past into the future. This temporal orientation would in turn pave the way to a better understanding of the potential sources of attitude change and the accompanying limitations and biases of human information processing.

In the previous section, we argued that time plays a significant role in the IT adoption process. In order to explain *why* the decision maker's attitude towards the success of an IT changes over time, we need to lay out an articulated theoretical foundation. In this section, the major sources of attitude change, along with the limitations and biases on the decision maker with respect to information acquisition and use are discussed. Furthermore, pertinent issues related to the measurement of change are reviewed.

2.1. Sources of Attitude Change

In general, attitude change can occur by changing the cognitive component, the affective component, or the behavioral component of an individual's attitude (Triandis, 1971, pp.142-46). Changes in the cognitive component could be caused by new information received from other people or through the mass media, which in turn entails changes in the affective and behavioral components. More specifically, attitude changes can be attributed to dissonance, temporal setting, and direct experience with the attitude object, brief descriptions of which are provided below.

As stated earlier, attitudes are changed to eliminate or reduce dissonance, i.e., they change to become more consistent with the implications of an event. Numerous studies have provided conceptual bases for the dissonance phenomenon, some of which are briefly reviewed here (for a comprehensive review, see Frey, 1982).

Steele and Liu (1983) attribute attitude change following a counter-attitudinal advocacy to an ego-based need for positive and efficacious self-image, rather than an inconsistency among cognitions. Tedeschi et al. (1971) maintain that people change their attitudes in an attempt to avoid being responsible for reprehensible behaviour. Seta and Seta (1982) demonstrate that the effort leads to more positive attitudes towards the goal object. The dissonance created by the effortful experiences may cause the attitude towards the goal to become more positive. Cooper and Croyle (1984) present the selective exposure proposition to explain cognitive dissonance. Specifically, they maintain that people seek information that supports a decision, and avoid contradictory information. Schwartz et al. (1980) argue that dissonance is a better predictor of selective exposure than the appearance of impartiality. Frey (1981) concludes that people desire supporting over discrepant information, because it provides the consonant cognitions that are important in reducing the magnitude of dissonance.

Apart from dissonance, temporal setting acts as another potential source of change in the decision maker's perceptual base. People's perception of past and future differ due to several sources such as the knowledge about the outcomes of an event, which as a correlate of temporal setting, affects judgement (see Doob (1971) for a compendium of these sources).

Attitudes also change through direct experience with the attitude object, which is assumed to provide the actor with an opportunity to acquire new information (Fishbein and Ajzen, 1975, p.411). For attitudes to play a role in the behavioral selection process, they must first be accessed from memory. Attitude accessibility is influenced by several factors including personal experience (Fazio et al., 1982; Sherman et al., 1982), and prior exposure to an attitude (Fazio et al., 1983).

Aside from the sources of attitude change, it is also important to understand how the limitations and biases related to information acquisition and processing influence the decision maker's judgement and attitudes. Many theorists (Pfeffer & Salancik, 1977, 1978; Staw, 1980; O'Reilly, 1983) have argued that in trying to achieve organizational goals, decision makers may develop strong preferences for certain outcomes. Since information plays a central role in the decision making process, it is crucial to highlight the sources and nature of potential biases that may influence decision making. These biases affect how information is acquired, and how it is processed cognitively.

At the acquisition stage, the decision maker is subjected to several types of bias, among which are:

- Preference for particular sources of information (Beach et al., 1978; Caldwell and O'Reilly, 1982)
- Avoidance of information which may suggest undesirable consequences (Janis and Mann, 1977)
- Seeking out supportive information (Lord et al., 1979)
- Selective perception such as structuring of problems on the basis of one's experience (Dearborn and Simon, 1958)
- Sensitivity to information as it relates to perception of time[1] (Graham, 1981)

The decision maker is also affected by many different types of biases at the processing stage. O'Reilly (1983) has divided these biases into two broad categories: limits on the decision maker's ability to process information, and biases related to the manner in which information is processed cognitively. Some of these limits and biases, which are relevant to the study of IT adoption process, along with their corresponding references, are listed below.

Limits on Information Processing

- Degradation of information in memory over time (Buckhout, 1974)
- Portraying and interpreting information as offering support for some favoured position (Buckhout, 1974; Ross and Sicoly, 1979)
- Forgetting unfavourable information or interpreting it as either irrelevant or favourable (O'Reilly, 1983)

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[1] Individuals representing different models of perception of time are receptive to different types of information.

Cognitive Biases

- Selective perception (Bruner and Postman, 1949; Janis and Mann, 1977; Snyder and Swann, 1978)
- Self-serving biases such as overestimating performance (Kidd and Morgan, 1966), overpredicting success (Larwood and Whitaker, 1977), escalating commitments of resources to failing projects (Staw and Fox, 1977), and attributing success to one's effort and failure to chance (Miller, 1976; Ross and Sicoly, 1979)
- Wishful thinking[2] (Marlock, 1967)
- Illusion of control[3] (Langer, 1975)
- Hindsight bias[4] (Fischhoff, 1976)

The informational base of the decision maker changes between the formation and maintenance stages of the adoption decision process. A major source for this change is the subject's varying degree of knowledge about the outcomes of the adoption. As the firm gets closer to the implementation of the system, the decision maker becomes more knowledgeable about the outcomes of the system under study. This, combined with the above information and judgemental limitations and biases, would in turn affect the decision maker's attitude toward the success of the system.

The impact of these biases on the adoption decision process depends, among

[2] People's preferences for outcomes of events affect their assessment of the events.

[3] Activity related to an uncertain outcome can induce feelings of control over the uncertain event.

[4] Finding plausible explanations for past events.

other things, on the conditions in which the biases occur. If the link between the persuasion stage and confirmation stage is short, then the decision maker can improve the decision making by taking corrective action. On the other hand, if the link is long and subject to distortion, the adopter will have difficulty in providing adequate inputs in the adoption decision process.

2.2. Measurement of Change

Golembiewski et al. (1976) argue that if organizational development efforts actually succeed, the very criteria for assessing the organization would also change. They then propose three conceptually different types of change as follows:

> *Alpha Change involves a variation in the level of some existential state, given a constantly calibrated measuring instrument related to a constant conceptual domain. Beta Change involves a variation in the level of some existential state, complicated by the fact that some intervals of the measurement continuum associated with a constant conceptual domain have been recalibrated. Gamma Change involves a redefinition or reconceptualization of some domain, a major change in the perspective or frame of reference within which phenomena are perceived and classified, in what is taken to be a slice of reality.*
>
> *Golembiewski et al. (1976, pp. 134-135)*

Since we are interested in attitude change of the decision maker between two points in time, we need to gain a better understanding of the inherent characteristics of these three types of changes. To begin with, let us differentiate between *degree* and *state* of change. First-order changes in *degree* occur within a system which itself remains unchanged. This type of change is analogous to alpha change. On the other hand, second-order changes in *state* change the system itself, i.e., they are change of change (Watzlawick et al., 1974). This type of change is similar to gamma change in that it entails a major change in the perspective within which phenomena are perceived. If the change occurs in a constant state but involves recalibration of the intervals used to measure some stable dimension of reality, then beta change occurs (Golembiewski et al., 1976). It should be noted that this typology of change is closely tied to the objectives of behavioral intervention. In other words, detecting and distinguishing the types of change help in establishing objectives of an intervention and assessing whether objectives have been achieved (Armenakis and Zmud, 1979). More specifically, if the purpose is to improve a system's performance and to reflect this improvement by measuring users' perceptions of the system's success, then alpha change may be intended. In contrast, if the purpose is to change individuals' understanding of the system's success, then gamma change may be intended.

Although some (Lindell and Drexler, 1979, 1980) have shown reservation about the efficacy of the factorial approach in isolating alpha, beta, and gamma changes, many others (Bedeian et al., 1980; Randolph and Edwards, 1984; Terborg et al., 1980; Zmud and Armenakis, 1978) have focused on methodological and conceptual problems to improve methods and approaches related to the measurement and conceptualization of these change. These studies have particularly directed attention to alternative approaches of detecting and isolating alpha, beta, and gamma changes. A review of all these approaches and methods is beyond the scope of this chapter. However, in order to show how the concepts of alpha, beta, and gamma changes relate to the measurement of attitude at two points in time, we will review a recent study related to the perceived effectiveness of office information systems.

Rice and Contractor (1990) applied the typology of change to test whether the implementation of a new office information system changes the way individuals conceptualize office work. This was done by measuring changes in perception of work effectiveness, defined as (p. 303) "the application of a system to accomplish individual, unit and organizational missions." A group of office workers were surveyed before the implementation of a system of desktop personal computer (T_1). The office was surveyed again after the implementation of the system (T_2). Apart from these "pre-" and "post-" measures of the effectiveness perceived in the performance of generic office activities, the respondents' perceptions of effectiveness before implementation as viewed in retrospect were also assessed via the "then" measures (T_3).

Alpha, beta, and gamma changes can be assessed by examining the analysis of covariance structure. For example, in the above study, identical inter-item correlation matrices at T_1, T_2, and T_3 would indicate alpha changes. Inequalities among the correlation matrices at T_1, T_2, and T_3 would reveal a beta change or a gamma change. Confirmatory factor analysis can be used to isolate these two changes. Inequalities among factor loadings, item variances, and factor variances indicate a presence of recalibration of the scales (beta change), while changes in factor structure and/or inequalities in covariance between factors at T_1, T_2, and T_3 indicate a reconceptualization of scales (gamma change).

Several results emerged from the analysis of data in the above study, some of which are pertinent to our study of attitude change. First, Rice and Contractor concluded that the respondents downgrade their prior criteria for effectiveness because they come to perceive how they can be more effective (beta change). This finding is in accord with our previous discussion of knowledge and experience as potential sources of information processing bias. That is, because of direct experience with an attitude object, the respondents acquired new information, which in turn led to recalibration of measurement continuum (beta change) and/or reconceptualization of the dimensionality of the construct of effectiveness (gamma change).

Second, the results indicated that the respondents' retrospective assessments ("then") of effectiveness, rather than their "pre-" or "post-" assessments, are the principal source of gamma change. In other words, the basis for most gamma changes is the respondents' changed conceptualization of how effective they thought they really were before implementation. This tentatively implies that in the conventional "pre-"/"post-" studies, we should expect to observe primarily alpha and beta changes, and not gamma change.

Finally, Rice and Contractor maintained that recall data about pre-implementation conditions are not in doubt simply because of poor respondent memory or other potential sources of bias. Rather, if a new system does really have subtle conceptual effects, recall data may be "then" measures of possible beta or gamma effects rather than surrogate "pre-" measures used to detect alpha change. This finding further highlights the inadequacies of cross-sectional studies, one-shot surveys that treat innovation process as timeless (Rogers, 1983, p. 133), and even longitudinal analyses that do not explicitly identify the types of changes involved (Golembiewski, 1986).

3. SUMMARY

This chapter examined the concept of time as it relates to the information technology adoption process. Using the diffusion theory as a springboard, we explored the five stages of the innovation decision adoption process, and subsequently developed a model of information technology adoption and assessment process. In laying out the theoretical groundwork of this model, we directed particular attention to the role of attitude formation/confirmation during various stages of the adoption and assessment process.

The second section of the chapter focused on the concept of attitude change. We briefly described three models of perception of time in order to set a common ground for our subsequent treatment of time as an influential factor effecting attitude change. Then, we discussed various sources of attitude change. In particular, we examined several theories in order to set the conceptual bases for the examination of dissonance as a source of attitude change. In addition, we reviewed the roles of knowledge of the outcomes of a decision and the individual's direct experience in the process of attitude change. Since biases related to information acquisition, processing, and use influence the decision maker's judgement and attitudes, we also provided an inventory of these limitations and biases. Finally, we examined various issues surrounding measurement of change. We used the alpha, beta, and gamma typology of change to differentiate between the degree and state of change. Conceptual and methodological problems were discussed, and their implications for the study of information technology adoption process were examined.

The discussions in Chapters 2-4 provide the theoretical foundations necessary for testing the major research hypotheses. In Chapter 2, we developed a conceptual framework for IS success. Based on this framework, we showed that a system's performance is a function of a) the system's capacity in terms of handling information, b) the system's quality in terms of preserving the accuracy of information, and c) the cost of the system. In Chapter 3, we developed a hierarchical model of IS in order to highlight the generic properties of successful systems as well as properties specific to each class of systems. In Chapter 4, we tied these two models to develop a conceptual model of IT adoption and assessment process. It was shown that environmental and economic factors influence the decision to adopt a system. We also argued that the IT adoption and assessment process is dynamic, and that the perception of the decision maker may change between various stages of the adoption. Furthermore, we contended that the success of a system is a function of the system's attributes and certain contextual variables.

In the next chapter, we will focus on various methodological issues related to the research design, measurement instrument, pilot study, sampling, and statistical analysis. It will be shown that IS success is based on a dynamic hierarchical structural model, which is composed of some generic properties shared by all systems and some other properties that are specific to a particular type of systems. We will also propose a methodology to investigate the role of time in the IT adoption and assessment process.

CHAPTER 5 - RESEARCH DESIGN AND MEASUREMENT

Design research as a poem, not as a novel.

Richard Daft[1]

This chapter is divided into two major parts. First, various issues related to the research design, measurement, statistical analyses, and sampling techniques employed in the study will be discussed. In the second part of the chapter, i) tests of non-response bias will be presented, ii) the sample's demographic information will be introduced, and iii) descriptive statistics pertaining to the EDI program in the adopting firms will be outlined. The ramifications of the sample demographics and the descriptive statistics of the EDI program for future research will be briefly highlighted.

The empirical findings of the survey relating to the major research hypotheses are presented in Chapter 6. No loss of continuity will be caused by skipping the present chapter.

1. BASIC RESEARCH DESIGN

Kerlinger (1973, p. 300) defines research design as "... the plan, structure, and strategy of investigation conceived so as to obtain answers to research questions and to control variance." Table 5.1 exhibits the basic research design of this dissertation.

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[1] "Learning the Craft of Organizational Research," *Academy of Management Review*, 1983, 8, 539-546.

The primary objective of the research design is to empirically investigate the two principal hypothesis set out earlier: i) that the decision makers' perceptions of IS success change over time, and ii) that the success of different classes of IS exhibit different structural models. It should be noted that in this study, EDI systems will be used as a special type of external systems. The main reason for selection of EDI is that since this technology is relatively new, it is easy to gather information from groups of firms at different stages of the adoption process. Specifically, we gathered information from firms that had already adopted EDI, firms that were in the process of adopting it, and firms that had not yet adopted it. All firms in the sample had also internal systems in place.

Table 5.1. Basic Research Design*

	Internal	External
G1	o []	o []
G2	o []	o []
G3	o []	[]

o Denotes dependent variable (overall success)
[] Denotes independent variables (factors influencing the success)
G_1 Denotes group of firms with EDI system in place
G_2 Denotes group of firms in the process of adopting EDI system
G_3 Denotes group of firms without EDI system

* Since EDI success is assessed retrospectively, it is not possible to measure it in firms that have not yet adopted this type of system.

A comparative examination of these firms will allow investigation of the role that time plays in the decision makers' perceptions of the factors influencing the success of EDI. The theoretical foundation of this hypothesis was set out in Chapter 4. Similarly, based on our discussion of the hierarchical nature of IS success in Chapter 3, a cross examination of the decision makers' perceptions about the success of internal and external systems will pave the way to studying the potential differences between the structural models of success of these two types of systems.

2. MEASUREMENT

In order to operationalize the research variables, we relied on the existing scales as well as new measurement scales. First, the short form of the User Information Satisfaction scale, originally developed by Bailey and Pearson (1983) and refined by Ives et al. (1983) and Baroudi and Orlikowski(1988), was employed to capture the respondents' perceptions about different aspects of *all* information systems and services in the firm. As discussed in Chapter 2, the UIS instrument is one of the most widely used scales in MIS research (Miller, 1989) even though it suffers from several conceptual and methodological difficulties. The short form of UIS is seemingly encountered by some difficulties.[2] Because of the absence of a more reliable and valid instrument, however, it was decided to use this scale. The short form of UIS was employed to gauge the respondents' overall satisfaction with all information systems and services in the firm in order to establish a base line for

[2] Galletta and Lederer (1989) outline the problems with this instrument, among which are test/retest reliability failure.

comparison of the research results with the existing data in the literature.

Second, the structure of success as applied to internal and external systems was examined using a new scale. This scale was developed based on the procedure suggested by Churchill (1979), who outlines the following sequence of eight steps involved in developing better measures of marketing constructs:

1. Specification of domain of constructs,
2. Generation of sample of items,
3. Collection of data,
4. Purification of measure,
5. Collection of data,
6. Assessment of reliability,
7. Assessment of validity,
8. Development of norms.

2.1. Specification of Domain and Generation of Items

The domain of the construct under study was specified as success of information systems. In Chapter 2 we argued that in order to identify and measure changes effected by IS, we need to develop valid and reliable instruments and recalibrate them. To this end, we relied on our conceptual model of IS success as well as the literature to generate the sample of items representing the construct under study. Four major groups of items were identified as principal dimensions of IS success: system's characteristics (F1), quality (F2), system's outcomes (F3), and users' requirements (F4).

The first group of items, labelled system's characteristics, was included to capture system's capacity, quality, and cost effectiveness. System's capacity, defined as the ability to achieve certain performance benchmarks in terms of storing, processing, and transmitting information in a given time interval, was measured via two items: adequacy of the system's storage capacity (1.1) and processing speed (1.2). Other system's characteristics were measured through reliability (1.3), ease of use (1.4), and accessibility of the system (1.5). The overall cost effectiveness of the system was assessed through one item (1.6).

Quality was included in the scale to capture *system's quality*, defined in our conceptual framework of IS success as the correspondence between certain real world states and the representation of these states by the system. Quality was operationalized through the following six items: accuracy (2.1), relevance (2.2), completeness (2.3), precision (2.4), reliability (2.5), and timeliness of output information (2.6). The first five items were drawn from the short form of UIS. The last was added because its importance is emphasized in the literature (e.g., Galletta and Lederer, 1989).

The third group of items focused on the outcomes of systems. The inclusion of these items was made in light of our previous critique of the literature that the existing UIS measures ignore output-oriented components of the system by limiting their scope to cognitive and affective dimensions. The extent to which the system's outcomes influence its success was operationalized through eight items identified by

Sokol (1989):

. Improvement of the company's image in industry (3.1)

. Improvement in customer services (3.2)

. Increase in inter-corporate transactions (3.3)

. Enhancement of inter-corporate coordinative efforts (3.4)

. Increase in sales (3.5)

. Decrease in inventory, personnel, or transaction costs (3.6)

. Reduction in paper work (3.7)

. Improvement in capturing and controlling of data (3.8)

User requirement was measured through five items in the questionnaire. Three of these items - overall support provided to users by MIS staff (4.1), users' understanding of the system (4.2), and users' participation (4.3) - were drawn from the short form of UIS scale. The other two items were added on the recommendation of Miller (1989) to gauge the impact of top management involvement (4.4) and training provided to users (4.5) on the overall success of the system. A complete list of these variables is provided in Chapter 6.

All these items were measured using a 5-point Likert scale, where respondents indicated the extent to which each item influenced the success of an information system. In addition, the respondents were asked to rank the first five most important items that they felt influenced the success of EDI and internal systems. This was done to measure the importance of the factors that influence IS success using a different scale. This multi-method operationalization of variables will provide further insight into basic structure of IS success.

For each type of system, three overall questions were also included. The first question asked the respondents to rate the overall degree of success of each class of systems in their company. The next question enquired about the extent to which each class of systems had achieved its objective in the company. The last question was included to measure the respondents' satisfaction with each class of systems. These three questions are used as surrogate measures of IS success.

In addition to the questions related to the primary research hypotheses, 18 descriptive questions were also included in the questionnaire. Three general questions enquired about the stage of implementation of EDI and the size and line of business of the company. Six questions focused on various characteristics of the respondents, such as educational background, title, and degree of familiarity with EDI systems. Finally, nine questions were specifically included to gather information related to various aspects of EDI, such as degree of penetration of EDI in the company, the standard format used, and the barriers to using EDI.

2.2. Purification of Measures

The next step in the scale development cycle was the purification of measure. This was done through personal interviews with 25 subjects, with the objective of examining whether the items in the questionnaire were distinct, exhaustive, meaningful, and unambiguous. These subjects were randomly selected from our mailing list. The interviews moved from open-ended questions to a highly structured item-by-item examination of the draft questionnaire.

First, through open-ended questions, the precise language within which the constructs were perceived by a majority of the participants as well as the concepts introduced by several participants was noted.

In the second part of the interviews attempts were made to improve the reliability of the scale. Because misunderstanding of questions would contribute to measurement error, eliminating ambiguous items would decrease error variance, and hence increase reliability (Kerlinger, 1973, p. 454). To this end, the subjects were asked to evaluate a draft of the questionnaire item-by-item, eliminating meaningless and redundant questions. Through an aggregate analysis of these feedbacks most of unclear questions were reworded.

One of the objectives of this stage of pretesting was to produce a content-valid instrument. To this end, we tested to see whether the items in the questionnaire were drawn from a universal pool representing the research constructs. As Cronbach (1971) and Kerlinger (1973) have noted, a means of doing this is to have experts familiar with the content universe evaluate the instrument several times until a consensus is reached. This was achieved by conducting the interviews in several waves so that each version reflected the suggested changes up to that point. Furthermore, in order to obtain maximum feedback, the participants were selected from three groups: academics (methodology), MIS mangers (technical issues), and EDI managers (business issues). In addition, provisions were made to include firms representing the characteristics of the final sample, taking into account such factors as firm's size and industry. Finally, since some items might potentially confound the results by the way they systematically influence the distributions of scores of respondents and non-respondents (Mitchell, 1985), provisions were also made to test whether a lack of variance in an item was caused by non-response bias.

2.3. Reliability and Validity

Reliability refers to the accuracy or precision of a measuring instrument; i.e., it is the degree to which a measure is free of error. It is measured by dividing the true variance to the total obtained variance of the data yielded by a measuring instrument (Kerlinger, 1973, p. 443).

It should be noted that there is no universally accepted level of reliability; a different level of reliability is sought that accords with the purpose of a study.

> *What a satisfactory level of reliability is depends on how a measure is being used. In the early stages of research on predictor tests or hypothesized measures of a construct, one saves time and energy by working with instruments that have only modest reliability, for which purpose reliabilities of .60 or .50 will suffice... For basic research, it can be argued that increasing reliabilities beyond .80 is often wasteful.*
>
> *(Nunnaly, 1967, p. 226)*

Reliability measures can be divided into two major classes: measures of stability and measures of equivalence. When reliability is assessed by correlating a measure across time, it is called a measure of stability, or test-retest reliability. Three major problems with test-retest reliability estimates have been identified. First, there is the problem of memory, which occurs when the interval between measurements is short. The respondents may remember their earlier responses, thus making them appear more consistent than they actually are. Second, the assumption of uncorrelated measurement error at t_1 and t_2 cannot always be held, because if the errors of measurement are in some sense systematic and not random, the same sources of bias might operate at each measurement. Third, true change cannot be distinguished from unreliability in a simple test-retest reliability design. This last problem is particularly serious when there is a long time interval between measurement and remeasurement (Bornstedt, 1983, pp. 77-89).

More recently, measures of equivalence have been used as alternative measures of reliability. One of the earliest varieties of equivalence measures has been the split-half methods. The use of these methods, however, has been diminished in favour of internal consistency methods, which utilize the covariances among all the items simultaneously rather than focusing on a single correlation between two arbitrary splits. The most popular measure of internal consistency was developed by Cronbach (1951).

In this project, Cronbach's alpha for all factors produced by the factor analysis will be calculated. In the case of low reliability (i.e., $a < 0.80$), the following guidelines will be followed to improve the instrument (Kerlinger, 1973, p. 454):

1. Re-examination of items to rid them of ambiguity,
2. Re-examination of the instructions to the instrument,
3. Addition of more items in order to increase the probability of accurate measurement, if there are a relatively small number of items representing the construct.

4. Elimination of items if there are a sufficiently large number of items. One way of eliminating items is to plot item-to-total correlations by decreasing order of magnitude, and then eliminating items with correlations near zero or items that produce a substantial drop in the item-to-total correlations (Churchill, 1979).

The second primary criterion in assessing an instrument is validity. There are several types of validity. Construct validity is the degree to which a scale actually measures the theoretical construct that it purports to measure (Cook and Campbell, 1979, p. 59). Construct validity can be initially checked by examining the link between the individual items and the theory underlying the construct under study. The scale's validity will be higher if its items are closely related to theory. Then, attempts should be made to include items that are based on existing validated instruments. Finally, convergent and divergent validity should be assessed. Convergence means that "...evidence from sources gathered in different ways all indicates the same or similar meaning of the construct". Discriminability, by contrast, means that "...one can empirically differentiate the construct from other constructs that may be similar, and that one may point out what is *unrelated* to the construct" (Kerlinger, 1973, p. 462).

Two methods of construct validation will be employed in this project: the correlations between total scores and item scores, and factor analysis. As Kerlinger (1973) has noted, the most powerful method of construct validation is factor analysis as it allows the examination of the underlying structure of the measures. Factor analysis will be used to extract the principal factors constituting IS success. Items that do not adequately load will be dropped. In addition, convergence and discriminability will be tested. Within each identified factor, an item score will be subtracted from the total score of that factor in order to avoid a spurious part-whole correlation (Cohen and Cohen, 1975). Then, correlations between all items and all the adjusted total factor scores will be calculated. For each item, checks will be made to see if its correlation with the corresponding total factor score is greater than its correlations with other total factor scores. Items that do not meet this criterion will be re-examined for ambiguity.

The final validity check is criterion-related validity, which is assessed by comparing scale scores with some criterion variable of interest. The criterion variable might be one which exists in the present (concurrent validity) or one which we might want to predict in the future (predictive validity). The former type of validity is assessed by correlating a measure and a criterion at the same point in time, while the latter is assessed by correlating a measure administered at a given point with a criterion of interest at some later point in time (Bornstedt, 1983, p. 97). As Kerlinger (1973, p. 460) has pointed out, the greatest difficulty surrounding criterion-related validity is obtaining the criterion itself, because no measure has a single criterion-related validity coefficient.

The results obtained from this scale will be compared with those available in the literature as well as those obtained from the short form of the UIS scale.

3. STATISTICAL ANALYSES

3.1. Exploratory Factor Analysis

In order to gain a better understanding of the inner workings of factor analysis, the theoretical underpinnings as well as the underlying assumptions of this technique will be briefly discussed here.

Factor analysis is motivated by the idea that the observed correlations among a set of measures can be explained by a smaller number of unobserved variables (common factors). Thus, each observed variable may be expressed as a sum of a part that is its regression on a number of common factors and a residual about that regression (McDanold, 1985, pp. 50-62). This description may be expressed mathematically as:

$$(5.1) \quad y_j = f_{j1} x_1 + f_{j2} x_2 + \ldots\ldots + f_{jm} x_m + e_j \qquad j = 1, \ldots\ldots, n$$

where y_j is the jth observed variable; x_p is the pth common factor, $p = 1, \ldots, m$; e_j is the residual of y_j about its regression on the factors; and f_{jp} is the regression weight of x_p on y_j, together with the statement that the residuals are uncorrelated.

It should be noted that for any set of manifest variables there are an infinite number of solutions that can account for the observed covariances among the observed variables equally well (Bohrnstedt, 1983, p. 89). Therefore, in order to obtain a unique solution, some constraints on the solutions need to be placed. For example, it is possible to transform a given factor pattern into a simple structure,[3]

[3] A factor pattern has simple structure when each variable has nonzero loadings on as few of the factors as possible. In other words, through simple structure, we explain the correlation of each variable with the others by a minimum number of common factors (McDonald, 1985, p. 81).

using orthogonal or oblique rotation.[4]

In exploratory factor analysis, the researcher is interested in testing the hypothesis that there are a certain number of common factors. There are two methods of estimation of the factor loadings and residuals: least squares and maximum likelihood (McDonald, 1985, pp. 52-61).

The goal of *least squares* factor extraction is to minimize squared differences between the observed and reproduced correlation matrices. Since this method of extraction does not provide a test of significance of the hypothesis, *generalized least squares* is used to produce a chi-square test of fit in large samples.

The *maximum likelihood method* estimates population values for factor loadings by calculating loadings that have the greatest probability of yielding a sample with the observed correlation matrix. This method produces a quantity called *likelihood ratio criterion*, which is a distribution-free measure of misfit of the estimated parameters to the sample correlations. This quantity also allows testing the hypothesis of m factors against the alternative hypothesis that the population is not constrained in any way.

Because of the limitations inherent in exploratory factor analysis, Tabachnick and Fidell (1989, pp. 601-605) propose several theoretical and practical guidelines for using this statistical technique. Attempts were made to follow these guidelines in our research study.

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[4] Orthogonal transformation assumes that factors are principles of classification that should be as independent as possible, while in oblique transformation factors that are uncorrelated in one population may well be correlated in another (McDonald, 1985, p. 87).

1. Generating of hypotheses about factors believed to underlie the domain of interest; i.e., making the research inquiry broad enough to include five or six hypothesized factors so that the solution is stable. We hypothesized that there are four factors underlying the concept of IS success: system's characteristics, information quality, system's outcome, and user requirements.
2. Including of five or six variables for each factor. Each of our research factors originally included five to eight variables.
3. Having at least five cases in the sample for each observed variable. For both internal and external systems this criterion was met.
4. Checking for normality of all variables. Since a majority of multivariate statistical analyses are based on the assumption that variables follow a normal distribution, we inspected all variables for significant departure from normality by inspecting histograms of all variables. This issue, however, does not pose any serious problem in confirmatory factor analysis because recent advancements in statistical theory allows handling of non-normal distributions (Bentler, 1989, p.2).
5. Requiring Kaiser's measure of sampling adequacy[5] in excess of .60. This requirement is satisfied in our analysis. The Kaiser's values will be provided in the next chapter.

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[5] This measure is a ratio of the sum of squared correlations to the sum of squared correlations plus sum of squared partial correlations. The value approaches 1 if partial correlations are small.

3.2. Confirmatory Factor Analysis

Single-group and multigroup confirmatory factor analyses were performed to compare structural models of success of internal and external systems, as well as structural models of IS success as it relates to adopting and non-adopting firms.[6]

In confirmatory factor analysis, the researcher has some knowledge of the underlying latent variable structure (Joreskog, 1969). This knowledge may be based on theory, empirical research, or a combination of both. The researcher then specifies *a priori* that certain items are highly related to the latent variables they are designed to measure, but negligibly related to other factors (Byrne, 1989, p. 4).

In this research study, the EQS (Bentler, 1989) computer package was used to specify, estimate, and test the hypothesized interrelationships among the variables. This package was selected over the other popular package, LISREL (Joreskog and Sorbom, 1985), because it allows for the estimation of parameters and testing of models using the more general elliptical and arbitrary distribution theories.[7]

The statistical theory underlying EQS is based on the assumption of independent cases. In addition, statistical theory requires relatively large sample sizes. For normal and elliptical distribution, the ratio of sample size to number of free parameters to be estimated can go as low as 5:1. A ratio of 10:1 is recommended for arbitrary distributions.

[6] Only data related to EDI systems were used in the latter analysis.

[7] Elliptical theory loosens the strict normality requirement to permit a wider range of symmetrically distributed data, while arbitrary distribution theory permits modelling of data that has any distributional form (Bentler, 1989, p. 1).

In order to facilitate a discussion of structural equation models, a brief description of key concepts germane to its theory will be provided here.

The ordinary equation $y_j = f_{j1} x_1 + f_{j2} x_2 + \ldots\ldots + f_{jm} x_m + e_j$ serves as the basic building block of all linear structural models. It is well known that the parameters of the equation are regression coefficients (Bentler, 1989, p. 16). It is somewhat less recognized that the variance of the residual is also a parameter to be estimated. This specification, however, does not apply to linear structural models. Bentler and Weeks (1980) specify the parameters of linear structural models to be the regression coefficients and the variances and covariances of the independent variables of equation (5.1).[8] Since the data vector of a model with n measured variables consists of $n(n+1)/2$ elements,[9] structural models must be constructed so that free parameters to be estimated are less than the number of elements in the data vector.

In EQS, observed variables are denoted by **V**s and their residuals by **E**s. The hypothetical constructs are referred to by **F**s and their residuals by **D**s. In addition, the hypothesized effects of variables on each other are specified. For example, if factor F1 is presumed to generate the covariances of measured variables V1 and V2, the relationship between them can be represented by the diagram and the corresponding structural equations in Figure 5.1.

In this model both V1 and V2 are a linear combination of the latent variable

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[8] It should be noted that parameters may include higher-order multivariate product-moments such as skewness and kurtosis of independent variables (Bentler, 1989, p. 206).

[9] with n elements as variances and $n(n-1)/2$ elements as their pairwise covariances.

F1. The direction of the arrows shows that both V1 and V2 are dependent variables and F1 is the independent variable, and not the reverse. Free parameters to be estimated, such as the regression coefficients or the variances of the dependent variables, are denoted by asterisks (*), preceded by the researcher's initial guesses about their values.

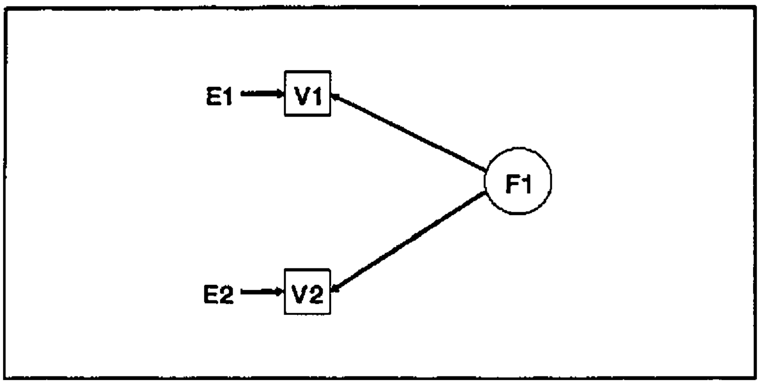

Figure 5.1. An Example of a Structural Model

(5.2)

```
/Equations
        V1 = .7*F1 + E1
        V2 = .7*F1 + E2

/Variances
        F1 = 1.0
        E1, E2 = *
```

Using the regression terminology, the above equations can be expressed as:

$$(5.3)\quad V_i = \beta_1 F_1 + \beta_2 F_2 + \ldots\ldots + \beta_m F_m + \beta_{m+1} E_{m+1}$$

where m is the number of factors that generate covariances of measured variables V_i.

Because identification of a model is based on the tenet that a structural model is specified so that the parameters of the model are unique, residuals and their variances deserve special attention.

> *Parameter, equation, and model identification is a complex topic that deals with the issue of whether a structural model has been specified so that the parameters of the model are unique.... Every unmeasured variable in a structural model must have its scale determined. This can always be done by fitting a path from that variable to another variable at some known value (usually 1.0). An alternative method for determining the scale of an independent unmeasured variable is to fix its variance at some known value (usually 1.0).*
>
> *(Bentler, 1989, pp. 17-18)*

Note that regression models are usually written so that the coefficient of the residual is fixed at 1.0 and then its variance is estimated as a free parameter. In model (5.3), however, we have fixed the variance of E_{m+1} at 1.0 and considered estimating β_{m+1} as a free parameter. It should be pointed out that it is not possible to free both parameters β_{m+1} and the variance of E_{m+1} because the product $\beta_{m+1}E_{m+1}$ must be a unique number given the other parameters. Likewise, it is not possible to fix both parameters (β_{m+1} and variance of E_{m+1}) because that would imply that residual variance is not to be estimated by optimal choice of the coefficients of the independent variables in the model.

In our example represented by equations in (5.2), we fixed coefficients of E1 and E2 at 1.0 and then considered estimating their variances as free parameters. The coefficient of F1, on the other hand, was set as a free parameter, but its variance was fixed at 1.0.

3.2.1. Research Models

In accordance with our discussion of the hierarchical structure of the concept of IS success, a brief coverage of higher-order and hierarchical solutions to confirmatory factor analysis is in order. As we argued in Chapter 3, the success of IS is composed of a) properties that are shared by all IS, and b) properties shared by certain major classes of systems (e.g., internal or external), and c) properties unique to each specific type of system (e.g., DSS). Confirmatory factor analysis allows treatment of such models in two different ways: Higher order factors and hierarchical factors.

Higher order factors assume that there exists a number of factors that are highly correlated and that these factors collectively measure a certain construct. This is analogous to oblique solutions in exploratory factor analysis. For example, as can be seen in Figure 5.2, through a second-order structural model we can hypothesize that IS success generates the covariances of four correlated factors, each of which in turn generates the covariances of several measured variables.

Alternatively, we can postulate that the construct of study is represented by factors at just one order: one general and a number of more specific ones (McDonald, 1985, p. 105). In our case, we can hypothesize that IS success is composed of five uncorrelated factors, of which the first is general and the other four are group factors in independent clusters (Figure 5.3). That is, the construct is represented by a model in which a general factor is supplemented by four group factors. Each measured variable is characterized by the general factor plus a group factor which represents the mutually exclusive properties of that variable.

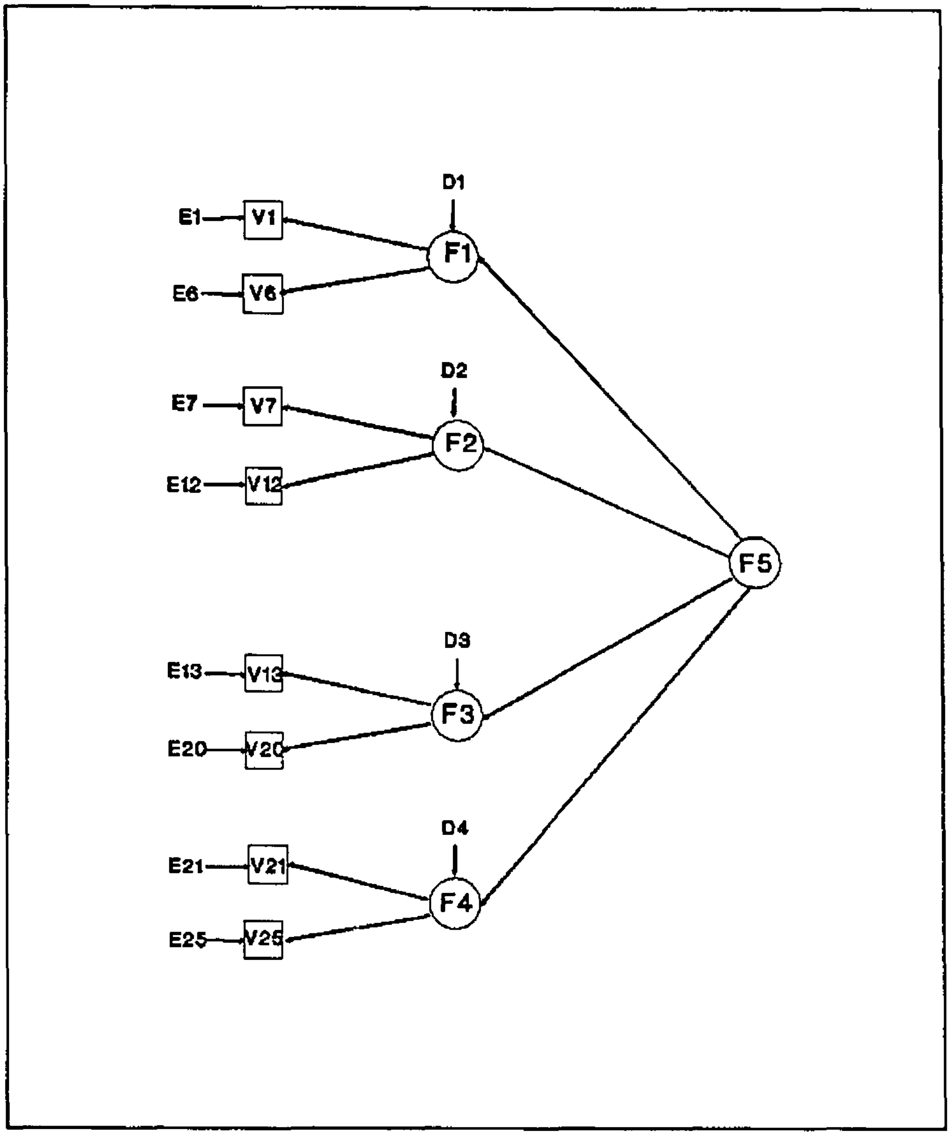

Figure 5.2. A Second-Order Structural Model of IS Success

F1 = System's Characteristics

F2 = Output Quality

F3 = System's outcomes

F4 = User requirements

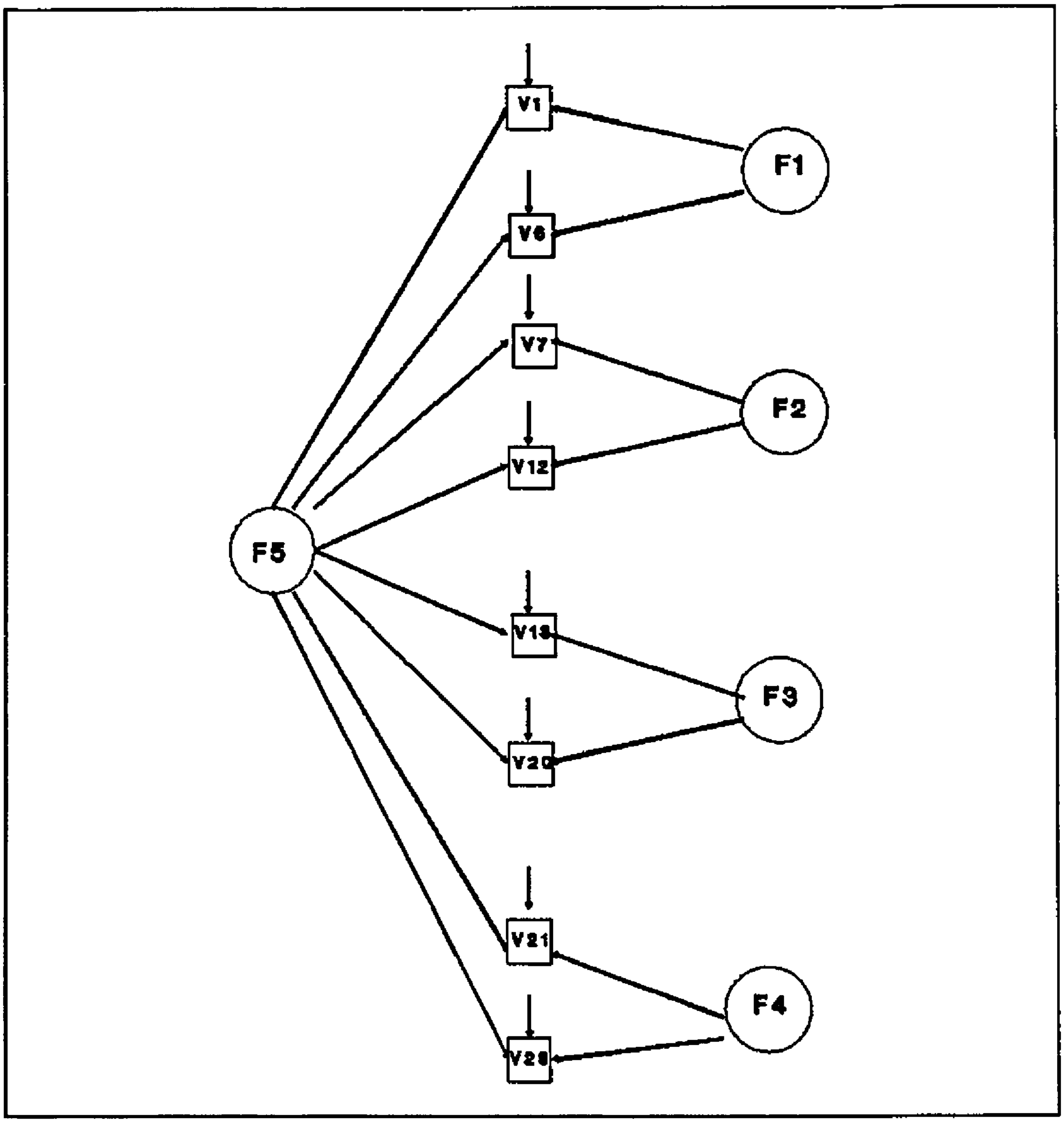

Figure 5.3. A Hierarchical Structural Model of IS Success

F1 = System's Characteristics

F2 = Output Quality

F3 = System's outcomes

F4 = User requirements

This model is particularly attractive in cases where data has been collected via only one source, such as questionnaire surveys. In such situations, if the correlations are low, it can be argued that the observed correlations among a set of variables are potentially due to the method factor, i.e., the correlations are generated due to the method by which data is collected. The general factor of a hierarchical model then includes variation caused by the method, while the remaining factors can be used to infer the underlying constructs that are being measured.

Fit of models will be assessed using three sets of tests available on EQS: i) Wald test used to assess goodness of fit of individual model parameters, ii) chi-square goodness of fit of the overall model, along with three fit indices, and iii) Lagrange Multiplier test.

In the following pages, the inner working of these tests will be described.

Wald Test

> *The W test has a natural application in evaluating whether a set of free parameters can be simultaneously constrained, usually set to zero. This might be done, for example, to test an a priori hypothesis, to obtain a more simplified model for purposes of interpretation, or to improve model fit be gaining degrees of freedom at only minimal loss to overall goodness of fit.* *Bentler (1989, p.129)*

This test can be considered to be a multivariate generalization of the square of the normal z-test, which tests the null hypothesis that a single parameter is zero in the population. In other words, the W test is concerned with restrictions that may be added without also disturbing model fit (Bentler, 1989, p.130). In essence, it is analogous to t-test used for significance of independent variables in backward stepwise regression models.

Chi-Square Goodness of Fit

The goodness of fit of the model is assessed via the χ^2 test, which tests the null hypothesis that sample data fits the hypothesized model. When the null hypothesis is not rejected, the model should fit data well and the p-value should exceed a standard cut-off (e.g., .05) in χ^2 distribution.

In addition to χ^2 goodness of fit, EQS provides three fit indices: Bentler-Bonett (1980) normed and nonnormed fit indices and Bentler (1980) comparative fit index. All these indices provide information regarding how well the model fits. Values greater than 0.9 are desirable (Byrne, 1989, p. 56; Bentler, 1989, p. 93).

Lagrange Multiplier Test

> *If a structural model does not fit sample data adequately, theory may suggest that certain fixed parameters, or restrictions, be released. The LM test evaluates the statistical necessity of the restrictions, based on calculations that can be obtained on the restricted model alone.*
>
> *Bentler (1989, p.126)*

This test is particulary useful in multi-sample analyses, where the researcher is interested in testing the equality constraints imposed on key parameters of the model. There two versions of LM test: i) the multivariate version, which tests all constraints simultaneously, and ii) a univariate version, which tests a single constraint. This test will be used to test the equality of factor loadings and uniqueness terms of the IS success model as applied to different classes of systems or to adopters and non-adopters of EDI.

3.3. Ranking

Since Likert scales do not take into account the relative importance of the items under study, the respondents were asked to rank the top five items that they felt influence the success of internal and external systems. The following algorithm was employed to analyze these rankings.[10]

Let R_{ij} = rank given to the jth item by the ith respondent

where $j = 1,\ldots,25$ items; $i = 1,\ldots,n$ respondents

(R_{ij} takes on values	0,	20,	21,	22,	23,	24)
	↑	↑	↑	↑	↑	↑
	not picked	5th	4th	3rd	2nd	best

Propose for each j, $P_j = \sum_i R_{ij}/(24n)$ as a measure of preference so that the 25 items can be ranked according to P_j, $j = 1,\ldots,25$.

Interpretation of P_j:

$$\text{Let } X_{ijj'} = \begin{cases} 1 & \text{if item } j \text{ is ranked} > j' \text{ by the ith respondent} \\ 0 & \text{otherwise.} \end{cases}$$

From the definition of R_{ij}, we have

$$R_{ij} = \sum_{\substack{j' \\ j' \neq j}} X_{ijj'}$$

---

[10] This algorithm was developed by Prof. T. K. Mak, Dept. of Decision Sciences & MIS, Concordia University.

$$\therefore \sum_i R_{ij} = \sum_i \sum_{\substack{j' \\ j' \neq j}} X_{ijj'} = \sum_{\substack{j' \\ j' \neq j}} \sum_i X_{ijj'}$$

$$P_j = \frac{\sum_i R_{ij}}{24n} = \frac{1}{24} \sum_{\substack{j' \\ j' \neq j}} \left(\frac{\sum_i X_{ijj'}}{n} \right)$$

Now $\left(\frac{\sum_i X_{ijj'}}{n} \right)$ is the proportion of the times item j is preferred to j'.

Thus P_j is ave. proportion (averaging over such proportions for $j' \neq j$, $j' = 1,\ldots,25$).

(Assumption: There are no preferences between two items ranked as 0 (i.e., not picked).

Based on the above algorithm, a BASIC program was written to identify the most important variables influencing success of each class of systems (Appendix 1).

3.4. Correlation and Regression Analyses

The relationships between overall satisfaction with information systems and services and the success of internal and external systems were tested using correlation analysis. Whereas for external systems only firms that had already adopted EDI or were in the process of adopting it were included in the analysis, all cases were used for internal systems. The four overall measures of satisfaction with all information systems and services were correlated individually with the three overall measures of success of each class of systems. In addition, regression analyses between independent variables and the three dependent variables were performed.

3.5. Other Analyses

Apart from descriptive statistics pertaining to the profile of the respondents in the research sample, the data were examined a) to gain a better understanding of the barriers to EDI adoption, and b) to see whether there is a relationship between the firms' characteristics and the arrival pattern of the questionnaires.

3.5.1. Barriers to EDI adoption

MIS literature has traditionally focused on factors influencing the successful development and implementation of information systems. As mentioned previously, we included a question in section III to identify the most important barriers to using or increasing the use of EDI. Five major barriers included in the question were system cost, security concern, lack of standards, lack of training, and management attitude (Sokol, 1989, pp. 87-93). Respondents were requested to indicate which of these barriers had hampered the growth of EDI in their firm.

3.5.2. Response effect

As a corollary to the methodology used in this study, attempts were made to gain a better understanding of various issues surrounding sampling method. As discussed previously, this study relied on non-traditional method of sampling. That is, instead of surveying all the subjects of interest, we first conducted a pre-survey, with the purpose of identifying the interested parties. The object of this mode of survey adminstration was to address the following questions:

1. Are there any differences between the respondents and non-respondents to the pre-survey, in terms of the respondent's profile cr the firm's characteristics?
2. Do the arrival dates of the final surveys filled out by the respondents and non-respondents to the pre-survey exhibi* :ifferent patterns?
3. Are there any differences between the characteristics of the early respondents and late respondents?

4. Are there any differences between the characteristics of the respondents and non-respondents to the final survey?

We created a file, keeping the arrival dates of the final survey as well as the names of the respondents. We identified the respondents and non-respondents to the pre-survey by colour-coding the final surveys. We were then able to make a comparative examination of the profiles of these two groups based on the following variables: the respondent's status in terms of being or not being an EDI user, the firm's size, the stage of EDI adoption, and the functional area of the respondent.

We also divided all the returned surveys according to their dates of arrivals in order to see if the early respondents differed from the late respondents. The surveys were divided into only two groups because a large proportion of the surveys (approximately two thirds) were received within the first two weeks of the mailing.

Next, we compared the patterns of the arrival dates for the two groups, trying to see whether the pre-survey's respondents responded to the final survey in a more expeditious manner than the non-respondents.

Finally, checks were made to examine possible differences between the respondents and non-respondents. This was done by comparing the results of the original mailing and those of the second one that had been mailed to non-respondents.

4. SAMPLING

Diffusion researchers have used survey research as a convenient methodology. One of the major weaknesses of this methodology is its dependence on recall data from respondents, which ignores the process aspect of the diffusion of innovation. In order to minimize the shortcomings of surveys, several alternative research methods are suggested: a) field experiments, b) longitudinal panel studies, c) use of archival records, and d) case studies with data from multiple respondents. Rogers (1983, p.117) has recommended four research strategies in order to lessen the seriousness of the respondent recall problem:

1. Selecting case studies that have recently diffused rapidly and are salient to the adopters.
2. Collecting data about respondents' time of adoption from alternative sources such as archival records.
3. Pretesting the survey questions carefully.
4. Using high-quality interviewing by well-trained interviewers.

Downs and Mohr (1976) have also pointed out some of the conceptual issues arising out of research in innovation. They have subsequently outlined several recommendations, two of which are of particular relevance to this study: a) focusing on single-innovation design, rather than multiple-innovation design, and b) making a distinction between the extent of adoption and time of adoption as measures of innovativeness.

In this study attempts were made to follow the four strategies suggested by Rogers (1983), taking into account the suggestions of Downs and Mohr (1976). Because of the relatively short time required for the implementation of EDI, this research is a good candidate for the study of innovation. In addition, a combination of interviews and surveys was employed to collect the required data.

4.1. Pre-Survey - Stage 1

The membership lists of two organizations were used in the survey phase of the study: the EDI Council of Canada and the Canadian Information Processing Society (CIPS). Sampling was performed in three waves:

First, in November 1990, a one-page letter was sent to 2201 potential respondents (Appendix 2-a). The 437 listings located in Quebec received the French copy of the letter, while the remainder (1601 in Canada and 163 in the U.S.A.)

received the letter in English. The pre-survey contained the mailing list of the EDI Council in its entirety (1678). The Council estimates that 600-700 companies in this list have already adopted EDI, while the remaining are in various stages of the adoption process.[11] In addition to this mailing list, 523 companies were randomly selected from the CIPS mailing list, which contains information on several thousand member companies. Only companies that were not on the EDI Council's mailing list were selected from this list in order to ensure that there would be a sufficient number of companies without EDI in the final sample. It should be noted that this mailing list was extracted from the 1988 CIPS annual survey of IS expenditure, and thus potentially contained some out-dated information.

In the pre-survey letter, the members of these two organizations were informed of the impending survey and were asked if they would be interested in participating in the project. In order to plan for adequate representation of the desired groups of companies in the sample, the participants were asked to indicate the stage of implementation of EDI in their company by stating whether they had already adopted EDI, were in the process of adopting it, or had not yet adopted EDI. Furthermore, they were asked to make any necessary corrections to the mailing label used in the pre-survey.

The date of the arrival of responses to the pre-survey was marked for further analysis. By the end of January 1991 the arrival of responses had tapered off to one or two letters per week. In total, 633 (27.4%) companies expressed interest in participating in the survey. The breakdown of these firms is shown in Table 5.2.

[11] This includes companies that are in the process of conducting a feasibility study, determining technical specifications, or legal and auditing requirements.

Table 5.2. Breakdown of Respondents to Pre-Survey

With operational EDI	265
Without EDI	245
In the process of adopting EDI	95
Missing	28
TOTAL	633

4.2. Pre-Survey - Stage 2

In the second stage of the survey, provisions were made to check for potential non-response bias. As Scheaffer et al. (1990, p. 33) have pointed out, one of the most important sources of non-sampling error is non-response bias. Cochran (1977, p. 359) identifies four types of non-response: i) non-coverage, which is the failure to locate some units in the sample, ii) not-at-homes, iii) unable to answer, and iv) hard core, who adamantly refuse to participate. One approach to detecting non-response bias is to take a random subsample of non-respondents and make a major effort to interview everyone in the subsample (Hansen et al., 1946).

In this study, 334 companies from the non-respondents file were randomly selected for the purpose of detecting any potential biasing factors. Of these, 289 were sent a follow-up letter on February 6, 1991, informing them again about the survey (Appendix 2-b). This time, however, the respondents were asked to return the letter only if they wished not to participate in the survey. In total, 55 (19%) letters of refusal were received by the time of the mailing of the final survey. Eight more letter of refusal were received after this date. In addition, 17 letters (approximately 6%) were returned because of incorrect address and/or the move of the respondent to another company. The remaining 45 companies were contacted by telephone between February 4 and 8, 1991. Because of budgetary constraints, only companies in the Montreal region were selected for telephone interviews. These respondents were asked, in the official language of their choice, whether they had received the pre-survey, and whether they would be interested in participating in the final survey. The following is a summary of the results of this enquiry:

- A significant number (16) said they had not received the pre-survey because they had changed jobs, had been moved, or because their mailing list was incomplete or incorrect (35.5%).
- Four had disconnected phones (9%).
- 13 were either not interested in EDI or too busy to take part in the survey (29%).
- Seven could not remember receiving the pre-survey because of the large amount of mail they receive (15.6%).
- Three persons were unknown to the company (6.7%).
- Two had not responded because they did not speak French (4.4%).

It was found that approximately half of the subjects did not respond because did not remember receiving the pre-survey or because of problems related to the mailing lists, such as inaccurate or out-dated information. This group (25 subjects) was included in the final mailing list. About one third of the subjects in the telephone follow-up attributed their non-response to not being interested or being too busy. This group, as well as the unknown subjects, was excluded from the final survey.

4.3. Final Survey

The last stage of the sampling related to the final survey questionnaire. This questionnaire was mailed on February 25, 1991 to a) all who had expressed interest via the pre-survey (633), and b) the interested parties from the non-respondents' mail and phone follow-up surveys (242). The questionnaires to these groups were unobtrusively colour-coded to make comparison of the results possible. The cover letter explaining the purpose of the survey was drafted in both English and French (Appendix 2-c). However, it was decided to administer the questionnaire in English only because of the potential conceptual and methodological problems which might arise from translating the existing measuring scales.[12] The respondents were requested to return the questionnaires by March 20, 1991. In order to improve the response rate the following provisions were made:

- Subjects received a personalized letter with their name and address printed on top. The researcher's signature was scanned and printed on the letters.
- The questionnaires were typeset in McGill's official colours: white and red.
- The endorsement of the two endorsing professional associations was obtained. These endorsements were mentioned in the cover letter and displayed on the front page of the questionnaire.
- The respondents were promised a summary of the research results. They were also informed that the survey was a part of a doctoral dissertation.

Since one of the corollaries of the research design was to investigate the effect of the ordering of questions on responses, three different versions of the questionnaire were printed (Appendix 3).

> *No topic in questionnaire construction is more vexing or resistant to easy generalization than that of question order. That question order can affect the distribution of responses to items has been amply demonstrated.*
>
> *(Bradburn, 1983, p. 302)*

The three main groups of items related to IS success factors were presented in different order. One version started with items related to quality of output, which contained "accuracy of output information" as the first item. Another version began

[12] A case in point is semantic differential scales. The reliability and content validity of these scales can potentially be attenuated if the exact meanings of the adjectives used in the scale are not captured in the translation process.

with items pertaining to system's characteristics, with "overall cost-effectiveness" as the first item. The third version started with items related to system's outcomes, having "improvement of company's image" as its first item. The three versions of the questionnaire were randomly distributed among the subjects in the sample.

By March 20, 1991, 33 questionnaire had been returned because of inaccuracies in the mailing list. Fifteen respondents indicated that they were not in a position to fill out the questionnaire because they were not involved in EDI, worked in trade associations or consulting firms, or were no longer interested in the project. Two hundred and eight usable questionnaires had been returned up to that date. One hundred and seventy requested the research summary result, and therefore included their names and addresses.

From March 20 to 22, 1991, an extensive telephone poll was undertaken. The final mailing list was checked to exclude the names of the known respondents (170). Then, all companies located in Montreal (85) as well as out-of-town companies with telephone numbers on the mailing list (108) were contacted and asked about the questionnaire. These companies were requested to fill out the questionnaire and return it if they not had yet done so. By April 30, 1991, another 80 questionnaires were received.

In order to gain further insight into non-response bias, another wave of surveys was mailed out on May 3, 1991. A second copy of the questionnaire was mailed to 460 companies. The new mailing list was based on the one used in the final survey, but excluded the names of a) those who had responded to the survey and asked for the results (235), b) those on the undelivered envelopes (33), c) those who had not filled out the questionnaires for various reasons but returned it (15), and d) those who had indicated in the telephone follow-up that they were not interested in the survey (25). By June 17, 1991, ninety four usable questionnaires were received. Table 5.3 shows the chronology of the final survey.

Table 5.3. Chronology of the Final Survey

Date	No. Sent	No. Received
Feb. 25	875	
Mar. 20		208
Apr. 30		80
May 3	460	
June 17		94
TOTAL	1335	382

Before entering data into the computer, each questionnaire was manually inspected in order to eliminate partially-filled out or incomplete surveys. After this initial screening, each questionnaire was given a three-digit identity code. The date of arrival of the questionnaires was also marked on the front page. In total, 382 usable questionnaires were included in the analysis.

5. DATA ENTRY

Questionnaires were coded before data were entered into the computer. dBase III was used in data entry. In order to prevent fatigue and thus improve accuracy, two provisions were made: a) the tasks of reading and entering the data were rotated periodically between the author and a research assistant, and b) each data entry session was limited to about three hours.

Since the direction of the items in the UIS instrument (positive to negative) differs from that of the other scales used in the project, a BASIC program (Appendix 4) was written to recode the items of the UIS instrument. This program also recoded the values of the success factors of two of the three versions of the questionnaire in order to facilitate the statistical analyses.

After the completion of data entry, the overall integrity of data was ensured by means of the following four-item screening checklist.

1. Accuracy of Data

All items were checked for out of range values. Discrepancies were identified and the correct values of the unmatched items were re-entered.

2. Missing Data

There are alternative ways to treat missing data. If only a few cases have missing values and they seem to be randomly scattered through the data matrix, then deletion of cases or variables is an appropriate option. This procedure of *listwise deletion* is commonly available in popular statistical packages.

Alternatively, one can estimate missing values using one of the popular schemes such as means or regression. The advantage of estimating missing values is that valuable data are not lost because of a few missing items in a case. In the absence of all other information, the mean is the best estimate of the value of a variable. It should be noted that the procedure of *pairwise deletion* has the advantage of being conservative, as the mean for distribution does not change and the researcher is not required to guess at missing values. On the other hand, because the mean is closer to itself than to the missing value it replaces, the variance of the variable is reduced, thus decreasing the correlations between the variables. It is recommended that the group mean be used for a missing value in order to alleviate some of the aforementioned problems (Tabachnick and Fidell, 1989, pp. 60-66).

A more sophisticated method for handling missing values uses regression. Variables with missing values are treated as dependent variables in regression equations using other independent variables. Cases with complete data are used to generate regression equations that are then used to predict missing values for incomplete cases. The advantage of this method is that a) it is more objective than the researcher's guess, and b) it provides more accurate estimates than inserting grand means. One disadvantage of the regression method is that the scores fit better than they should because missing values are predicated from other variables. This method also provides reduced variance because the estimates are probably too close to mean.

This study relied on the regression method for estimating missing values. Detailed discussion of this procedure will be provided in the next section.

3. Normality

Although a number of analyses used in this study rely on parametric statistics, the normality of variables does not seem to be a major problem. As Tabachnick and Fidell (1989, p. 74) have pointed out, in a large sample, a variable with a significant skewness or kurtosis often does not deviate enough from normality to make a realistic difference in the analysis. In addition, as will be discussed later, the major research hypotheses will be tested using a statistical package that yields estimates based on elliptical and arbitrary distributions.

4. Outliers

Outliers are caused by a) incorrect data entry, b) failure to specify missing values, c) inclusion of a subject from a non-representative population, or d) inclusion of a case from the intended population, but with extreme values on one or more of the variables (Tabachnick and Fidell, 1989, pp. 66-70). The provisions made during data screening eliminated the first two sources of outliers. The other two sources were checked via inspection of standardized scores of the variables of interest using the existing options in the statistical package employed in the study. The Z-score of all primary research variables[13] were calculated, looking for absolute values in excess of 3. Each problematic case was inspected individually to determine whether it

[13] This included 17 questions related to IS satisfactions, 28 related to EDI success, and 28 pertaining to internal systems.

belonged to the population under study. Provisions were made to reduce the influence of outliers by changing their values to one unit larger or smaller than the next most extreme score in their corresponding distributions.

No outliers were found for the IS satisfaction and EDI success variables. For the internal success variables, approximately six outliers per variable were detected, all of which had value of zero and therefore were ignored.

6. PRELIMINARY RESULTS

This section covers the preliminary results of the survey. First, the results of several tests of non-response bias will be presented. Second, the demographic information pertaining to various characteristics of the respondents and their companies will be outlined. Finally, descriptive statistics related to various aspects of EDI program in the adopting firms along with their implications for future research will be highlighted.

6.1. NON-RESPONSE BIAS

The questionnaires were divided into three groups according to their dates of arrival. The first group contained all questionnaires that had been received before the deadline of the first mailing (208). The second group consisted of questionnaires received after that date (78). The last group contained the second mailing's surveys (95). These three groups were cross tabulated with several demographics questions.

As can be seen in Table 5.1.1 through 5.1.6, no evidence of non-response bias was found based on the firm's size or stage of EDI adoption, nor on the respondents' functional area, management echelon, educational background, or being an EDI user. None of the chi-square tests of independence could be rejected.

Table 5.1.1. Test of Non-Response Bias - Size

	First Early	First Laggard	Second	Row Total
Small	72	25	36	133 39.0
Medium	54	23	23	100 29.3
Large	62	25	21	108 31.7
Column Total	188 55.1	73 21.4	80 23.5	341 100.0

χ^2 = 2.33 with 4 d.f., Sig. level = .674

Table 5.1.2. Test of Non-Response Bias - Stage of EDI Adoption

	First Early	First Laggard	Second	Row Total
Non-Adopters	63	18	30	111 29.3
Pilot	36	11	13	60 15.8
Adopters	107	52	49	208 54.9
Column Total	206 54.4	81 21.4	92 24.3	379 100.0

χ^2 = 4.27 with 4 d.f., Sig. level = .370

Table 5.1.3. Test of Non-Response Bias - Functional Area

	First Early	First Laggard	Second	Row Total
MIS	108	50	48	206 53.9
Non-MIS	100	32	44	176 46.1
Column Total	208 54.5	82 21.5	92 24	382 100.0

χ^2 = 2.08 with 2 d.f., Sig. level = .351

Table 5.1.4. Test of Non-Response Bias - Management Echelon

	First Early	First Laggard	Second	Row Total
President/VP	33	9	9	51 13.4
Director/Manger	115	40	53	208 54.5
Other	60	33	30	123 32.2
Column Total	208 54.5	82 21.5	92 24	382 100.0

χ^2 = 5.26 with 4 d.f., Sig. level = .260

Table 5.1.5. Test of Non-Response Bias - Educational Background

	First Early	First Laggard	Second	Row Total
Technical	82	32	38	152 40.4
Non-Technical	121	49	54	224 59.6
Column Total	203 54.0	81 21.5	92 24.5	376 100.0

χ^2 = .058 with 2 d.f., Sig. level = .971

Table 5.1.6. Test of Non-Response Bias - EDI Use

	First Early	First Laggard	Second	Row Total
Users	71	31	29	131 34.6
Non-users	135	50	63	248 65.4
Column Total	206 54.4	81 21.4	92 24.2	379 100.0

χ^2 = .869 with 2 d.f., Sig. level = .647

6.2. DEMOGRAPHICS

As mentioned previously, the first three sections of the questionnaire enquired about the demography of the responding firms, personal questions related to respondents, and questions related to the state of EDI adoption in the adopting firms. It should be noted that this sample was tailored to meet the research design of the study, and is not representative of the Canadian economy.

Table 5.2.1 shows the breakdown of firm size as measured by annual sales. Half of the responding firms have annual sales of less than $250 m., while the sales of the other half exceed this amount. As can be seen, there is a cross-sectional representation of firms of different size in the sample. This variable will later be used to a) check for non-response bias, and b) examine potential differences between the respondents' perception of IS success in large and small companies.

Table 5.2.1. Annual Sales

	Freq.	Percent
Less than $5 million	30	8.8
$ 5 - $ 9 million	13	3.8
$10 - $24 million	30	8.8
$25 - $49 million	32	9.4
$50 - $99 million	28	8.2
$100 - $249 million	39	11.4
$250 - $999 million	61	17.9
$1 billion or more	108	31.7
Total	341	100.0

Table 5.2.2 lists the industry in which the firms operate. The survey represents a variety of industries across the private sector of the economy, as well as government agencies. Major industries such as financial services, food and tobacco manufacturing, pulp and paper, transportation, and wholesale trade, as well as government agencies, are well represented in the sample.

Table 5.2.2. Industry

	Freq.	Percent
Chemicals	19	5.0
Communications	16	4.2
Financial	30	7.9
Food Manufacturing & Tobacco	27	7.1
Government	28	7.3
Insurance	14	3.7
Metals, Machinery & Equipment	15	3.9
Mining, Oil & Gas	11	2.9
Pharmaceutical & Health Services	17	4.5
Pulp & Paper, Printing & Publishing	23	6.1
Retail Stores	16	4.2
Transportation	24	6.3
Utilities	6	1.6
Wholesale Trade	23	6.0
Other	113	29.5
Total	382	100.0

Table 5.2.3 exhibits the stage of implementation of EDI. About 30% of the firms have no EDI program under way, about 28% are in the process of implementing EDI, and in the remaining 42% firms, EDI is in operation mode. The almost equal representation of these three types of companies provides a vehicle for an examination of IS success across the adopting and non-adopting firms.

Table 5.2.3. Stage of EDI Adoption

	Freq.	Percent
No EDI program under way	111	29.2
Feasibility study	45	11.8
Technical specs. & Legal req'ments	15	4.0
Pilot program	46	12.1
Currently EDI in operation mode	162	42.6
Total	379	100.00

Tables 5.2.4 through 5.2.9 are related to various personal aspects of respondents. Table 5.2.4 displays the breakdown of respondents according to their functional areas, while Table 5.2.5 displays their educational background. Slightly over half of respondents belong to Information Systems group, while the remaining are employed in other departments, notably Finance and Sales/Marketing. Forty percent of the respondents indicated computer science/MIS or engineering as their educational background, while 46% identified business administration or arts/sciences as their educational background. In Chapter 7, these two questions will be used to examine the potential differences between MIS and non-MIS people and between technical and non-technical people regarding their perceptions of IS success.

Table 5.2.6 lists the management echelon of respondents. Over half of the respondents identified themselves as middle managers, while 13% indicated that they are president or a vice-president in their company. A comparison of managers at different organizational level regarding their perceptions of IS success will shed some light on the role of stakeholders on the IS evaluation process. This hypothesis will be further investigated in Chapter 7.

Table 5.2.7 shows that approximately one third of respondents classified themselves as a user of EDI. The extent of respondents' familiarity and involvement with the EDI program in their company are also shown in Tables 5.2.8 and 5.2.9, respectively . As can be seen, over two thirds of respondents indicated that they are highly familiar or moderately familiar with EDI systems. Similarly, 70% maintained that they are very involved or moderately involved in the EDI project in their company. One of the principal hypotheses of the dissertation related to the role of involvement and familiarity in changing the perceptions of the assessors. We will examine this proposition in Chapter 7 to see whether greater degrees of familiarity with and involvement in a particular IS project, and the subsequent use of the system, will lead to a more favourable attitude towards the success of that project.

Table 5.2.4. Functional Areas of Respondents

	Freq.	Percent
Finance	45	11.8
Information Systems	206	53.9
Production/Manufacturing	5	1.3
Purchasing	15	3.9
Sales/Marketing	46	12.0
Transportation/Logistics	17	4.5
Other	48	12.6
Total	382	100.0

Table 5.2.5. Educational Background of Respondents

	Freq.	Percent
Computer Science/MIS	118	31.4
Business Administration	131	34.8
Engineering	34	9.0
Arts/Sciences	43	11.4
Other	50	13.3
Total	376	100.0

Table 5.2.6. Management Echelons of Respondents

	Freq.	Percent
President/VP	51	13.4
Director/Manager/Coordinator	208	54.5
Other	123	32.2
Total	382	100.0

Table 5.2.7. Classification Based on EDI Use

	Freq.	Percent
Yes	131	34.3
No	248	64.9
Total	379	100.0

Table 5.2.8. Degree of Familiarity with EDI

	Freq.	Percent
Highly familiar	113	29.7
Moderately familiar	145	38.1
Somewhat familiar	75	19.7
A little familiar	40	10.5
Not familiar at all	8	2.1
Total	381	100.0

Table 5.2.9. Degree of Involvement with EDI

	Freq.	Percent
Very involved	184	50.3
Moderately involved	71	19.4
Somewhat involved	42	11.5
A little involved	24	6.6
Not involved at all	45	12.3
Total	366	100.0

6.3. EDI PROGRAM

Table 5.3.1 through 5.3.10 show various aspects of the EDI program in the adopting firms. As shown in Table 5.3.1, 42% of the firms indicated "Request from trading partners" as the main reason for their company to use EDI, while "Push by industry", and "Response to internal inefficiencies" was selected by 20% and 18% of the firms, respectively. An interesting area for future research is to see whether the primary motivation for the adoption a particular information technology will play any role in the evaluation process of that technology.

Table 5.3.1. Reasons for EDI Adoption

	Freq.	Percent
Request from trading partner(s)	115	41.7
Push by industry	51	18.5
Response to internal inefficiencies	56	20.3
Other	54	19.6
Total	276	100.00

One of the main criticisms of diffusion research relates to *pro-innovation bias*, which assumes that an innovation should be adopted by all members of a social system (Rogers, 1983, p. 92). This bias leads to the *post hoc* examination of successful innovations by ignoring the rejection and discontinuance of innovations. In order to diminish the effects of pro-innovation bias, Rogers (1983, p. 95) recommends the study of innovations while the diffusion process is under way.

A recent survey of 1504 business managers selected from all major private sectors of the U.S. economy indicated that EDI is in the expansion stage of the S-shaped diffusion curve (EDI Research, 1989). The results of this survey, as shown in Tables 5.3.2 to 5.3.6, confirm this findings. Table 5.3.2 shows that among 90% of the adopting firms, less than 25% of inter-corporate documents are currently exchanged via EDI. However, more than half of the responding firms believe that more than half of their inter-corporate documents will be exchanged via EDI in the long run (Table 5.3.4). Table 5.3.3 shows the monthly number of documents exchanged via

EDI. Less than 1000 documents per month are exchanged by 70% of the adopting firms. Tables 5.3.5 and 5.3.6 display the length of time that EDI has been in use. Only 25% of the firms have been using EDI for more than five years, while EDI has been in use for less than three years in over half of the firms.

The in-process research design used in this study will make an investigation of the *process* of the diffusion of EDI possible.

Table 5.3.2. Percentage of Doc. Exchanged Via EDI

	Freq.	Percent
0%	81	28.8
1% - 24%	172	61.2
25% - 49%	20	7.1
50% - 74%	3	1.1
75% or more	5	1.8
Total	281	100.0
Ave.		12.18

Table 5.3.3. Monthly No. of Doc. Exchanged Via EDI[14]

	Freq.	Percent
Less than 100	108	45.2
100 - 999	58	24.2
1,000 - 4,999	43	18.0
5,000 - 9,999	13	5.5
10,000 - 24,999	7	3.0
25,000 - 99,999	8	3.3
100,000 or more	2	.1
Total	239	100.0
Ave.		5465

[14] In calculating the average, the mid-point of the last class was assumed to be 250,000.

Table 5.3.4. Percentage of Doc. to be Exchanged Via EDI in the Long Run

	Freq.	Percent
1% - 24%	39	19.5
25% - 49%	50	25.1
50% - 74%	44	18.4
75% or more	66	33.0
Total	199	100.0
Ave.		54.2

Table 5.3.5. Year the First EDI Document Received

	Freq.	Percent
65 - 79	5	2.7
80 - 84	14	7.8
85	10	5.5
86	16	8.7
87	24	13.1
88	32	17.5
89	41	22.4
90	31	16.9
91	9	4.9
Total	182	100.0

Table 5.3.6. Year the First EDI Document Sent

	Freq.	Percent
65 - 79	7	4.1
80 - 84	15	8.8
85	7	4.1
86	13	7.6
87	19	11.0
88	28	16.3
89	45	26.2
90	27	15.7
91	10	5.8
Total	171	100.0

Table 5.3.7 shows that the predominant standard format used in adopting firms is ANSI X.12 (63%). About 11% of the firms use proprietary standards, 3% use the EDIFACT platform, and the remaining 23% use other standards. A similar survey by EDI Research Inc. (1989) showed that the following breakdown of EDI standard formats: ANSI X.12 (42%), Proprietary (18%), EDIFACT (3%), Other (37%).

Sokol (1989, p. 91) maintains that one of the major factors impeding the implementation of EDI has been the lack of standards. Comparing the results of these two surveys, it appears that the trend is away from proprietary and other standard formats and towards ANSI X.12 format. The implication of this finding is that we should expect to see a more rapid diffusion of EDI as ANSI X.12 is developed for a larger number of cross-industry standard business transactions.

Table 5.3.7. Types of Standard Format

	Freq.	Percent
ANSI X.12	150	62.8
Proprietary	26	10.9
EDIFACT	8	3.3
Other	54	22.6
Total	238	100.0

One of the major challenges facing firms adopting EDI has been the integration of EDI with the internal systems (Sokol, 1989, p. 66). When asked whether EDI system is fully integrated with the internal systems of the company, only half of the adopting firm indicated so (Table 5.3.8). Based on this finding, it seems that the vendors of EDI services need to focus on the development of EDI interface programs in order to facilitate the integration of EDI with intra-company systems.

Table 5.3.8. State of EDI Integration with Internal IS

	Freq.	Percent
Yes	126	51.0
No	121	49.0
Total	247	100.0

Although EDI is becoming an integral part of the daily operations of a large number of firms, 37% of the adopting firms indicated that no full-time person works on their EDI project (Table 5.3.9). This finding is in line with one the primary objectives of EDI in terms of reducing labour costs associated with processing of transactions.

Table 5.3.9. No. of People Working on EDI Project

	Freq.	Percent
None	96	36.6
1-2	102	39.0
3-5	40	15.2
6 or more	24	9.2
Total	262	100.0

Table 5.3.10 highlights the most important barriers to the use of EDI. The most frequently mentioned barrier is management attitude (95 times), followed by system cost (78 times), lack of training (49 times), lack of standards (47 times), and security concerns (15 times). The implication of this finding for companies that are in the process of EDI adoption is that middle management needs to pay particular attention to convincing upper management about the potential benefits of EDI (Sokol, 1989, p. 93).

Table 5.3.10. Barriers to EDI Use

	Freq.
System cost	78
Security concerns	15
Lack of standards	46
Lack of training	49
Management attitude	94

6. SUMMARY

In this chapter, various issues surrounding research design, measurement, sampling, and statistical techniques employed in the study were discussed. First, it was shown that the research design of this dissertation is based on a dynamic cross-examination of the adoption process of two major types of information systems.

Second, issues related to the measurement of the construct under study were discussed. Guidelines suggested in the literature were followed in the questionnaire design and scale development processes of the study. In addition, provisions were made to address the problems of non-response error and response effect. The former source of error was examined through a multiple-stage surveying method, while the latter types of error were investigated by examining the extent to which different ways of measuring the research variables influenced the type of response.

Then, the inner workings of exploratory factor analysis and confirmatory factor analysis were briefly discussed. Two major types of linear structural models were used to develop alternative structural models of IS success.

Next, the details of the three stages of sampling procedure used in the survey were explained. In the pre-survey stage, respondents received a letter of invitation to participate in the survey. Those who had not returned the pre-survey were subsequently sent a second letter soliciting their participation in the survey. The final survey was initially mailed to those parties who had expressed interest in the survey. A follow-up survey of non-respondents was performed in order to ensure that the results of the study are not affected by non-response bias. Based on several tests, no indication of non-response bias was found.

Finally, using the demographic information of the sample, it was shown that the sample contained adequate representation across industries, functional areas of business, and stages of EDI adoption.

CHAPTER 6 - RESEARCH FINDINGS

The discussions in Chapters 2-4 culminated in a dynamic hierarchical structural model of IS success. The specific properties of this model were expounded through four major hypotheses.

The first hypothesis related to the hierarchical nature of IS success. We argued that IS success is based on a hierarchical structure, which encompasses i) properties shared by all IS, ii) properties related to the environment within which the system operates, and iii) properties unique to each specific type of system.

The second hypothesis pertained to the role of time in the IS evaluation process. We maintained that a large number of biases affect the human information processing cycle over time. The decision maker's perception of the success of an IS, we hypothesized, changes during various stages of the adoption and assessment process.

The third hypothesis related to the role that different stakeholders play in the evaluation process. Specifically, we contended that different stakeholders evaluate the success of an information system differently.

The last hypothesis pertained to the evaluation function of IS success. In light of a lack of concrete theoretical or empirical evidence as to the association between different types of measurement methods, we hypothesized that IS success is a multi-dimensional construct.

In this chapter, the research hypotheses will be tested using the sample data.

First, the results of this study will be compared with the existing scales of IS success. Attempts will be made to provide empirical evidence regarding the difficulties associated with the existing surrogate measures of IS success. Second, using linear structural modelling techniques, the stability of IS success across different types of systems as well as across time will be tested. The third hypothesis will be tested by comparing the perceptions of different echelons of management, technical and non-technical people, and MIS and non-MIS people. The last hypothesis will be tested using different scales of IS success.

1. A COMPARISON OF IS SUCCESS MEASURES

We factor analyzed the items related to the short form of UIS scale. For each of the 13 variables, first the linear composite of the two corresponding items was calculated. Then a 3-factor pattern was produced. In [illegible] the recent criticism of this instrument (Galletta and Lederer, 1989), our analysis reproduced the original factor structure of the instrument. For UIS scale, the varimax factor matrix, the eigen values and the reliability coefficients of the factors, as well as percentage of common variance explained by each factor, are shown in Table 6.1.1.

Table 6.1.1. Varimax Factor Matrix - UIS

	FACTOR 1	FACTOR 2	FACTOR 3
VAR1	.73754	.30384	
VAR2	.64481		
VAR3	.42963		.47137
VAR4			.75395
VAR5	.53605		.53883
VAR6	.60655	.33976	
VAR7	.36405	.66673	
VAR8	.33179	.61276	
VAR9		.81273	
VAR10		.76404	
VAR11	.70774	.37096	
VAR12	.61582		.31175
VAR13	.38508	.64120	
Eigen Values	6.88	1.27	.86
% of Variance	53.00	9.80	6.60
Alpha	.86	.89	.77

Next, we correlated the four summary questions of the UIS scale[1] and the linear composite of the three factors in the UIS scale with the three single measures[2] of overall success of internal and EDI systems. An examination of these correlations, presented in Table 6.1.2, reveals some interesting results. First, the correlations among UIS measures and overall measures of success of internal systems (ranging from .261 to .451) are found to be higher than those related to EDI systems (ranging from .107 to .368).[3]

[1] Respondents' overall satisfaction with their involvement in IS development (UIS 1), with support and services provided by the MIS department (UIS 2), with information product itself (UIS 3), and with the entire IS environment (UIS 4).

[2] Overall degree of success (SUC), extent to which objectives attained (OBJ), and satisfaction with the system (SAT).

[3] Only firms with operational EDI were used in these analyses.

Table 6.2.2. Correlations Between Overall Satisfaction and Success Measures

	FAC 1	FAC 2	FAC 3	UIS 1	UIS 2	UIS 3	UIS 4
SUC (INT)	.381**	.310**	.284**	.307**	.331**	.365**	.377**
OBJ (INT)	.357**	.266**	.262**	.322**	.295**	.353**	.371**
SAT (INT)	.432**	.383**	.366**	.411**	.419**	.451**	.446**
SUC (EDI)	.206**	.127	.169*	.145*	.107	.211**	.266**
OBJ (EDI)	.240**	.209**	.132	.187*	.219**	.325**	.304**
SAT (EDI)	.284**	.277**	.222**	.248**	.314**	.354**	.368**

** p-value = .01 * p-value = .05

Second, correlations between UIS measures and the single measures of satisfaction with internal and EDI systems are all higher than correlations between UIS measures and the other two single measures of success (Overall success and Attainment of objectives.) Third, correlations between the three single measures of IS success and FAC 1 (MIS staff and services) are higher than those related to the other two factors (Information output and Knowledge and involvement.)

These results can be attributed to the fact that since UIS was originally developed to measure satisfaction with conventional internal information systems, its domain is limited only to affective aspects of satisfaction with internal systems. The utility of the UIS scale, therefore, is questionable because this scale i) ignores outcome-oriented aspects of IS success and ii) neglects specific success factors pertaining to systems other than internal systems. Altogether, these results further corroborate our critique of the UIS scale presented in Chapter 2. Our theoretical coverage of IS success in addition to the above empirical results provide sufficient evidence regarding the conceptual and methodological difficulties associated with the UIS scale. In particular, we reiterate that the UIS scale does not take into account all the basic properties of successful information systems, thus its domain is narrowly limited to affective aspects of satisfaction with conventional internal systems. In this light, we call for a re-evaluation of this scale in terms of its efficacy in measuring IS success. As discussed previously in Chapter 2, the construct of IS success is based on a hierarchical structure model encompassing i) those generic properties shared by all successful IS, and ii) specific properties related to certain types of IS. The measures of IS success, therefore, should be related to affective as well as outcome-oriented dimensions of these properties.

2. A HIERARCHICAL STRUCTURAL MODEL OF IS SUCCESS

In the structural model of IS success presented in Chapter 5, we maintained that IS success can be measured through four factors. The following 25 items were used to measure these factors:

I. System's Characteristics (Section V. Questions 7-12)

1.1. Overall cost-effectiveness of the system (V7)
1.2. Reliability of the system (V8)
1.3. Ease of use of the system (V9)
1.4. Adequacy of system's storage capacity (V10)
1.5. Adequacy of system's processing speed (V11)
1.6. Accessibility of the system (V12)

II. Output Quality (Section V. Questions 1-6)

2.1. Accuracy of output information (V1)
2.2. Relevance of report contents to intended function (V2)
2.3. Completeness of output information (V3)
2.4. Precision of output information (V4)
2.5. Reliability of output information (V5)
2.6. Timeliness of report delivery to users (V6)

III. System's Outcomes (Section V. Questions 13-20)

3.1. Improvement of your company's image in industry (V13)
3.2. Improvement in customer services (V14)
3.3. Increase in inter-corporate transactions (V15)
3.4. Enhancement of inter-corporate coordinative efforts (V16)
3.5. Increase in sales (V17)
3.6. Decrease in inventory, personnel, or transaction costs (V18)
3.7. Reduction in paper work (V19)
3.8. Improvement in capturing and controlling of data (V20)

IV. Users' Requirements (Section V. Questions 21-25)

1. Overall support provided to users by MIS staff (V21)
2. Users' understanding of the system (V22)
3. Users' participation in the development and implementation (V23)
4. Training provided to users (V24)
5. Top management involvement in defining MIS policies (V25)

In order to test whether these items conform to the basic structural model developed in Chapter 3, all 25 items were factor analyzed for both internal and external systems. Maximum likelihood was used to estimate factor loadings and residuals of varimax and oblique solutions. The analyses were repeated for four, five, and six factors. Neither the four-factor structure nor the six-factor structure yielded interpretable results. The five-factor analysis, on the other hand, produced a factor pattern which captured the basic structure of the IS success model. One of the variables (Reliability of the system), however, loaded on the factor pertaining to quality of output. Since this loading was neither interpretable nor meaningful, it was decided to take a closer look at this item during structural modelling. The exclusion of this variable from exploratory factor analysis, nonetheless, did not affect the factor structure of the other variables in the model.

Two other changes to the original model were also observed. For both classes of systems, the outcome variables loaded on two factors instead of one. The first "outcome" factor consisted of the first five outcome variables:

Improvement of company's image

Improvement in customer services

Increase in intercorporate transactions

Enhancement of intercorporate coordinative efforts

Increase in sales

Since the last variable had a relatively small loading, and because of the commonality of the remaining variables in capturing various aspects of inter-organizational relations, this factor was tentatively labelled *Inter-corporate outcomes* (Factor 2). "Overall cost-effectiveness of the system" in addition to the remaining outcome variables loaded on another factor. This factor (Factor 3), which was labelled *Efficiency Outcomes*, consisted of the following items:

Decrease in inventory, personnel, or transaction costs

Reduction in paper work

Improvement in capturing and controlling of data

Overall cost-effectiveness of the system.

The other three factors fitted our designated factorial structure. These factors were subsequently labelled *Output Quality, System's Characteristics, and Users' requirements.*

These preliminary analyses highlighted the importance of outcome-oriented dimensions in measuring IS success. This in turn provided some guideline to subsequently refine the structural model of IS success.

Based on our discussion of the hierarchical structure of IS success, data were further examined in order to see whether the resulting factor structure applies to both classes of systems. We had initially expected that some items pertaining to specific characteristics of external systems would not be applicable to internal systems. An examination of the frequencies of the scores of internal systems showed that a sizable portion of respondents had checked as "not applicable" the items related the "Inter-corporate outcomes." In this light and in accord with our theoretical discussion of IS success in Chapter 3, this factor was subsequently designated as a specific factor related only to EDI systems.

For EDI systems, the varimax factor matrix, the eigen values and the reliability coefficients of the factors, as well as percentage of common variance explained by each factor, are shown in Table 6.2.1. Table 6.2.2 relates to internal systems. Only factor loadings greater than .3 are printed.

In order to test validity of our basic structural model, the results of the exploratory factor analysis were transformed into the corresponding second-order and hierarchical structural models.

Table 6.2.1. Varimax Factor Matrix - EDI Systems

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
V1	.71214				
V2	.49662				
V3	.75704				
V4	.78629				
V5	.84582				
V6	.47124				
V7					.44097
V8	.49153				
V9	.32441				.40473
V10				.77277	
V11				.74432	
V12				.57549	
V13		.62706			
V14		.59169			
V15		.64176			
V16		.65728			
V17		.61114			
V18		.39704			.61269
V19					.79074
V20		.37080			.46711
V21	.34230		.34689		
V22			.70390		
V23			.74909		
V24	.30357		.66594		
V25			.42788		
Eigen Values	8.51	2.45	1.71	1.39	1.21
% of Variance	34.00	9.8	6.8	5.60	4.90
Cum % of Var	34.00	43.80	50.40	56.00	60.90
Alpha	.87	.81	.79	.79	.79

FACTOR 1 = Output Quality
FACTOR 2 = Inter-corporate Outcomes
FACTOR 3 = Users' requirements
FACTOR 4 = System's Characteristics
FACTOR 5 = Efficiency Outcomes

Table 6.2.2. Varimax Factor Matrix - Internal Systems

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
V1	.77035				
V2	.61123				
V3	.70300				
V4	.72745				
V5	.83929				
V6	.53636				
V8	.55202				
V9	.35823				.37766
V10					.76116
V11					.70201
V12	.30556				.55317
V13			.55292		
V14			.40511	.34178	
V15			.81365		
V16			.86494		
V17			.48730		
V18				.71608	
V19				.74102	
V20	.30320			.58791	
V21	.30300	.43953			
V22		.64443			
V23		.74249			
V24		.77800			
V25		.41917			
Eigen Values	8.33	2.72	1.71	1.34	1.21
% of Variance	33.30	10.90	6.90	5.40	4.80
Cum % of Var	33.30	44.20	51.10	56.50	61.30
Alpha	.90	.81	.80	.79	.77

FACTOR 1 = Output Quality
FACTOR 2 = Users' Requirements
FACTOR 3 = Not Applicable
FACTOR 4 = Efficiency Outcomes
FACTOR 5 = System's Characteristics

In the former model, it was hypothesized that, irrespective of the type of the system, IS success generates the covariance of four correlated factors (System's Characteristics, Output Quality, System's Outcomes, Users' Requirements). None of the second-order models resulted in adequate fit, and therefore were dropped. In the hierarchical model, on the other hand, we assumed that IS success is composed of five uncorrelated factors, of which the first factor is general and the other four are independent clusters.

Further to our discussion of the hierarchical structure of IS success, the basic model of IS success was refined so that it would fit both classes of systems. In this basic model, four factors were originally measured through 19 variables (all variables except system's reliability and five inter-corporate variables). All analyses were performed based on maximum likelihood and generalized least square estimates using both normal and elliptical distribution theory.

In general, results based on elliptical distribution yielded better fit than normal distribution. Similarly, results based on generalized least square estimates generally provided better fits than those based on maximum likelihood estimates. All subsequent analyses, then, were performed based on elliptical distribution.

Fit of models was assessed using three sets of tests available on EQS: i) Wald test used to assess goodness of fit of individual model parameters, ii) chi-square goodness of fit of the overall model, and iii) three fit indices also used to evaluate the overall fit of the model.

The basic model with 19 variables resulted in unsatisfactory fit due to variables in the *Users' requirements* factor and *Output Quality* factor. Based on the values of the W-tests of the individual variables, five variables had to be dropped from this model: two variables (Support of MIS staff, and Top management involvement) belonging to the *Users' requirements* factor, and three variables (Relevance of output, Completeness of output, and Timeliness of output) belonging to the *Output Quality* factor. The *Users' requirements* factor, then, consisted of three variables:

Users' understanding of the system,

Users' participation,

Users' training.

The *Output Quality* factor consisted of:

Accuracy of output information,

Precision of output information,

Reliability of output information.

This factor was subsequently labelled *Output Reliability.* Tables 6.2.3 shows an edited version of the results of the test of adequacy of the basic model (Model 1a) for EDI systems.[4] The chi-square of 72.84 yielded the p-value of .185 for the χ^2. Since the p-value exceeded the standard cut-off of .05, this test provided evidence in support of the null hypothesis that the sample data fits the basic model. The Bentler-Bonett Normed and Nonnormed fit indices and comparative fit index were all above the acceptable level of .90 (Byrne, 1989, p.56; Bentler, 1989, p. 93). Based on W-test with α = .05, none of the free parameters were dropped from the model.

As shown in Table 6.2.4, the basic model also fitted internal systems adequately, with χ^2 of 66.91 based on 63 degrees of freedom and p-value of .344 (Model 1b).[5] All three fit indices were over .990, indicating an almost perfect fit.

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[4] The Cronbach coefficient of α for F1 to F5 are .848, .861, .759, .737, and .812, respectively.

[5] The Cronbach coefficient of α for F1 to F5 are .864, .876, .775, .745, and .822, respectively.

Table 6.2.3. Model 1a - Measurement Equations of Basic Model - EDI Systems

V1	= .524*F1	+ .394*F2				+ E1
V4	= .491*F1	+ .430*F2				+ E4
V5	= .543*F1	+ .523*F2				+ E5
V9	= .637*F1		+ .183*F3			+ E9
V10	= .388*F1		+ .830*F3			+ E10
V11	= .393*F1		+ .669*F3			+ E11
V12	= .713*F1		+ .438*F3			+ E12
V7	= .471*F1			+ .360*F4		+ E7
V18	= .390*F1			+ .715*F4		+ E18
V19	= .461*F1			+ .801*F4		+ E19
V20	= .527*F1			+ .434*F4		+ E20
V22	= .676*F1				+ .439*F5	+ E22
V23	= .637*F1				+ .652*F5	+ E23
V24	= .585*F1				+ .463*F5	+ E24

Goodness of Fit Summary

χ^2 = 72.84 based on 63 d.f. p = 0.185

Bentler-Bonett Normed fit index = 0.992
Bentler-Bonett Nonnormed fit index = 0.998
Comparative fit index = 0.999

Table 6.2.5 shows the four generic factors shared by internal and external systems, along with the items measuring these factors. In order to see whether the five variables related to inter-corporate outcomes would fit a complete (as opposed to a basic) model of EDI success, these variables were introduced into the model. Based on W-test, two of the free parameters (Improvement in customer services and Increase in sales) were dropped. The new model fitted relatively adequately, with χ^2 goodness of fit of 139.24 based on 102 degrees of freedom and p-value of .008. The p-value for the χ^2 statistic was lower than the standard cut-off. However, in light of very high fit indices (Bentler, 1989, p. 93), the model was deemed acceptable.

Table 6.2.4. Model 1b - Measurement Equations of Basic Model - Internal Systems

V1	= .555*F1	+ .312*F2				+ E1
V4	= .606*F1	+ .332*F2				+ E4
V5	= .582*F1	+ .521*F2				+ E5
V9	= .532*F1		+ .116*F3			+ E9
V10	= .373*F1		+ .663*F3			+ E10
V11	= .502*F1		+ .592*F3			+ E11
V12	= .571*F1		+ .338*F3			+ E12
V7	= .369*F1			+ .128*F4		+ E7
V18	= .351*F1			+ .673*F4		+ E18
V19	= .377*F1			+ .778*F4		+ E19
V20	= .476*F1			+ .472*F4		+ E20
V22	= .479*F1				+ .398*F5	+ E22
V23	= .466*F1				+ .573*F5	+ E23
V24	= .485*F1				+ .505*F5	+ E24

<u>Goodness of Fit Summary</u>

χ^2 = 66.91 based on 63 d.f. $\quad$ p = 0.344

Bentler-Bonett Normed fit index	= 0.994
Bentler-Bonett Nonnormed fit index	= 0.999
Comparative fit index	= 1.000

Table 6.2.5. Generic Factors Shared by Successful Information Systems

<u>*Factor I - Output Reliability* (F2)</u>

Accuracy of output (V1)
Precision of output (V4)
Reliability of output (V5)

<u>*Factor II - System's Characteristics* (F1)</u>

Ease of use of the system (V9)
Adequacy of system's storage capacity (V10)
Adequacy of system's processing capacity (V11)
Accessibility of the system (V12)

<u>*Factor III - Efficiency Outcomes* (F3)</u>

Cost-effectiveness of the system (V7)
Decrease in costs (V18)
Reduction in paper work (V19)
Improvement in capturing data (V20)

<u>*Factor IV - Users' Requirements* (F4)</u>

Users' understanding of the system (V22)
Users' participation (V23)
Training provided to users (V24)

* Parentheses in front of factors contain corresponding factors in Figure 2.3.
Parentheses in front of items designate corresponding variable numbers in the questionnaire.

Table 6.2.6. Model 2 - Measurement Equations of Complete Model - EDI Systems

V1	= .517*F1	+ .391*F2					+ E1
V4	= .487*F1	+ .438*F2					+ E4
V5	= .525*F1	+ .533*F2					+ E5
V9	= .602*F1		+ .186*F3				+ E9
V10	= .423*F1		+ .811*F3				+ E10
V11	= .426*F1		+ .685*F3				+ E11
V12	= .694*F1		+ .434*F3				+ E12
V13	= .471*F1			+ .241*F4			+ E13
V15	= .502*F1			+ .710*F4			+ E15
V16	= .549*F1			+ .549*F4			+ E16
V7	= .528*F1				+ .268*F5		+ E7
V18	= .554*F1				+ .507*F5		+ E18
V19	= .585*F1				+ .732*F5		+ E19
V20	= .633*F1				+ .277*F5		+ E20
V22	= .638*F1					+ .445*F6	+ E22
V23	= .621*F1					+ .660*F6	+ E23
V24	= .560*F1					+ .487*F6	+ E24

Goodness of Fit Summary

χ^2 = 139.24 based on 102 d.f. $\quad$ p = 0.008

Bentler-Bonett Normed fit index	= 0.988
Bentler-Bonett Nonnormed fit index	= 0.996
Comparative fit index	= 0.997

Table 6.2.6 shows the measurement equations and goodness of fit summary of the complete model of EDI success (Model 2).[6]

3. INTERNAL VERSUS EXTERNAL SYSTEMS

In Chapter 2, we showed that the crux of IS success assessment should be the match between a system's original goals and its corresponding performance outcomes. We subsequently argued that all systems share certain generic properties represented by a hierarchical model. Since different types of IS are designed and implemented

[6] The Cronbach coefficient of α for F6 is .812.

with different objectives in mind, we hypothesized that the success of internal systems and external systems is based on i) certain generic properties shared by both types of systems and ii) certain properties specific to each type of systems.

In the previous section, we showed that the basic models of IS success (Models 1a and 1b) separately fit each class of systems almost perfectly. In order to test the hypothesis that the key parameters in the basic model are invariant across EDI and internal systems, two types of test were performed. First, paired-samples t-test of the variables across internal and external systems were performed. Based on the results of these tests presented in Table 6.3.1, means of the majority of the individual variables are found to be statistically different (two tail test, $p < .025$) for the two types of systems. There is insufficient evidence that means of the other nine variables are not equal for external and internal systems. These tests were repeated for each version of the questionnaire in order to remove any potential bias related to question order. Tables 6.3.2 - 6.3.4 show the results of these tests.

It can be seen that among the three versions the equality of means of 15 variables are rejected. There is insufficient evidence, however, that means of the following 10 variables are not equal. The parentheses in front of each item contain the factor comprising each variable.

V5 Reliability of output (Output Quality)

V6 Timeliness of output (Output Quality)

V10 Adequacy of system's storage (System's Characteristics)

V12 Accessibility of the system (System's Characteristics)

V18 Decrease in costs (System's Outcome)

V21 Support provided by MIS staff (Users' Requirements)

V22 Users' understanding of the system (Users' Requirements)

V23 Users' participation (Users' Requirements)

V24 Training provided to users (Users' Requirements)

V25 Management involvement (Users' Requirements)

A closer examination of these tests provides some interesting results. All the variables (V21 to V25) belonging to the *Users' Requirements* factor have statistically equal means. The other five variables with equal means belong to the other three variables. Further, means of all the five variables related to the inter-corporate outcomes are significantly different as expected. When examining the 14 variables in the basic structural model of IS success, only means of six variables were found to be likely equal.

Alternatively, we tested the simultaneous effects of all 14 variables influencing IS success using a two-sample analysis of the linear structural model of IS success (EDI vs. internal systems). This analysis was performed because "... we can often find two variables that are correlated have no relationship once other variables are controlled" (Bollen, 1989, p. 78). The two-sample analysis of the structural models provides not only tests for the overall structural fit of a model across the two samples, but also allows testing of equality of the key parameters in the model such as loadings and uniqueness.

Table 6.3.1. Paired-Samples T-Tests of Independent Variables (N = 305)

Variable	*Mean*	*S.D.*	*T*	*p-value*
V1	4.36 3.83	.[illegible]0 .86	10.79	.000
V2	4.09 4.20	.82 .79	-2.92	.004
V3	4.31 4.02	.79 .82	6.15	.000
V4	3.46 4.12	1.01 .87	-11.23	.000
V5	3.61 3.54	.98 1.07	1.11	.260
V6	3.61 3.62	1.01 1.08	-.22	.830
V7	3.58 3.96	1.03 .99	-6.63	.000
V8	3.33 3.47	1.09 1.06	-2.56	.011
V9	3.09 3.46	1.24 1.15	-4.91	.000
V10	3.77 3.84	1.08 .97	-1.25	.210
V11	3.74 3.50	.89 1.02	3.70	.000
V12	3.63 3.65	1.15 .99	-.35	.730
V13	3.69 4.32	1.15 .73	-8.71	.000
V14	3.87 3.99	.81 .81	-2.70	.007
V15	4.05 4.25	.85 .77	-5.74	.000
V16	3.87 3.63	.82 .86	4.08	.000
V17	4.14 3.71	.78 .87	8.77	.000
V18	3.66 3.74	.97 .95	-1.60	.110
V19	3.87 3.19	.91 1.00	9.82	.000
V20	3.77 3.03	1.02 1.01	11.66	.000
V21	3.11 3.13	1.00 1.14	-.31	.757
V22	3.43 3.45	1.03 1.02	-.32	.750
V23	3.79 3.89	.92 .79	-1.36	.170
V24	3.69 3.89	.84 .92	-3.72	.000
V25	3.79 3.81	.88 1.00	-.34	.733

Table 6.3.2. Paired-Samples T-Tests - Version 1 (N = 105)

Variable	*Mean*	*S.D.*	*T*	*p-value*
V1	4.40 3.93	.83 .81	5.66	.000
V2	4.21 4.31	.87 .76	-1.73	.086
V3	4.40 4.05	.80 .84	4.29	.000
V4	3.58 4.29	.99 .90	-7.14	.000
V5	3.65 3.64	1.01 1.12	.08	.937
V6	3.68 3.63	1.12 1.05	.56	.580
V7	3.39 3.54	1.22 1.11	-1.61	.110
V8	3.39 3.54	1.26 1.17	-1.61	.110
V9	3.30 3.61	1.22 1.34	-2.60	.011
V10	3.78 3.92	1.11 1.01	-1.43	.155
V11	3.70 3.57	.85 1.01	1.21	.228
V12	3.60 3.71	1.14 1.01	-1.13	.263
V13	3.68 4.40	.11 .70	-6.28	.000
V14	3.92 4.12	.78 .84	-2.60	.011
V15	4.17 4.35	.87 .75	-2.86	.005
V16	3.92 3.66	.78 .89	2.45	.016
V17	4.32 3.70	.79 .87	7.44	.000
V18	3.85 3.85	.94 .97	.00	.999
V19	3.86 3.37	.84 1.01	4.31	.000
V20	3.88 3.20	1.02 1.13	6.18	.000
V21	3.28 3.32	1.11 1.16	-.34	.733
V22	3.49 3.40	1.11 1.01	1.05	.294
V23	3.87 3.86	.88 .72	.10	.917
V24	3.80 3.91	.77 .90	-1.51	.134
V25	3.88 3.89	.82 1.03	-.01	.913

Table 6.3.3. Paired-Samples T-Tests - Version 2 (N = 110)

Variable	*Mean*	*S.D.*	*T*	*p-value*
V1	4.22 3.69	.85 .88	7.37	.000
V2	3.91 4.04	.83 .84	-2.46	.016
V3	4.12 3.93	.83 .88	2.34	.021
V4	3.38 3.86	1.06 .83	-5.40	.000
V5	3.53 3.40	.98 1.10	1.39	.167
V6	3.42 3.50	1.00 1.15	-.07	.482
V7	3.48 3.80	.97 1.02	-3.16	.002
V8	3.13 3.37	.95 1.01	-2.62	.010
V9	2.86 3.30	1.27 1.09	-3.12	.002
V10	3.60 3.62	1.04 .97	-.32	.752
V11	3.74 3.44	.89 1.03	2.99	.004
V12	3.69 3.65	1.15 .94	.41	.682
V13	3.74 4.19	1.18 .73	-3.77	.000
V14	3.78 3.91	.80 .73	-2.23	.028
V15	3.95 4.13	.77 .77	-4.02	.000
V16	3.87 3.61	.84 .85	2.11	.038
V17	3.88 3.62	.75 .95	3.10	.002
V18	3.44 3.58	.94 .91	-1.88	.063
V19	3.65 2.97	1.03 .96	5.87	.000
V20	3.56 2.78	.89 .84	8.13	.000
V21	2.92 2.87	.90 1.03	.04	.673
V22	3.37 3.38	.96 .98	-.11	.912
V23	3.66 3.85	.93 .82	-2.00	.048
V24	3.65 3.79	.86 .98	-1.62	.108
V25	3.76 3.73	.88 1.01	.31	.757

Table 6.3.4. Paired-Samples T-Tests - Version 3 (N = 90)

Variable	*Mean*	*S.D.*	*T*	*p-value*
V1	4.50	.67	5.80	.000
	3.90	.88		
V2	4.20	.70	-.98	.330
	4.27	.73		
V3	4.43	.70	4.07	.000
	4.06	.73		
V4	3.41	.97	-6.98	.000
	4.23	.80		
V5	3.66	.94	.56	.574
	3.59	1.00		
V6	3.75	.87	-.20	.841
	3.78	1.02		
V7	3.51	1.01	.13	.560
	3.50	.99		
V8	3.51	1.00	.13	.895
	3.50	.99		
V9	3.11	1.17	-2.76	.007
	3.47	1.04		
V10	3.96	.99	-.32	.747
	4.00	.84		
V11	3.76	.94	2.25	.027
	3.48	1.05		
V12	3.61	1.14	.21	.834
	3.58	.98		
V13	3.65	1.18	-5.18	.000
	4.40	.76		
V14	3.94	.83	.13	.894
	3.93	.86		
V15	4.02	.91	-3.26	.002
	4.27	.79		
V16	3.89	.85	2.51	.014
	3.61	.82		
V17	4.24	.71	4.88	.000
	3.82	.76		
V18	3.71	.98	-.92	.362
	3.80	.96		
V19	4.14	.76	7.01	.000
	3.26	.96		
V20	3.90	1.08	5.97	.000
	3.13	.97		
V22	3.44	1.03	1.62	.109
	3.60	1.06		
V21	3.15	.96	-.70	.485
	3.23	1.19		
V23	3.84	.96	-.38	.703
	3.88	.84		
V24	3.62	.42	-3.57	.001
	3.91	.87		
V25	3.71	.92	-.69	.489
	3.80	.95		

As was discussed in the previous section, we tested the stability of IS success across different types of systems through structural modelling techniques. In this section, we will impose two sets of constraints relating to the invariance of key parameters across the two classes of systems. First, the factor loadings of the two groups were constrained to be equal. If the observed variables were measuring the same factors in each of the two groups, the regression of these variables on the factors ought to be the same (Bentler, 1989, p. 151). Second, we tested the equality of unique or error variances and covariances. Even though this is the least important hypothesis to test, its acceptance would imply that all of the model's parameters are equal across groups (Bentler, 1981, p. 151). If the factors are assumed to be correlated, we needed to test the equality of factor variances and covariances across groups. This test was not applicable to our analyses because of the independence of the five factors of the hierarchical model.

Initially, only constraints related to the equality of the factor loadings were imposed. The χ^2 goodness of fit, however, was unsatisfactory. In addition, the constraint relating to V7 (System's cost effectiveness) failed the Lagrange Multiplier Test. Since, we had used three versions of the questionnaire with different ordering of the success variables, it was thought that the results were affected by the artifact related to the anchoring of responses. Therefore, it was decided to test the equality of factor loadings across the two groups for each version of the questionnaire separately. These three different models resulted in adequate χ^2 goodness of fit. In addition, the LM test verified that the cross-group equality constraints on factor loadings were all reasonable. The effect of the ordering of questions will be further investigated in the next chapter.

The second stage of analysis involved the inclusion of constraints related to the cross-group equality of unique or error variance and covariances. The list of the LM test for releasing these constraints and those related to the invariance of the factor loadings across two groups are shown in Table 6.3.5. The analyses of the second stage, in general, yielded satisfactory results. The models all fitted perfectly, and except for a few constraints related to error terms, all other constraints appeared reasonable. Tables 6.3.6 - 6.3.8 exhibit the goodness of fit summary of these analyses, along with the multivariate and univariate tests for releasing the constraints.

Table 6.3.5. Constraints Used in Lagrange Multiplier Test

Const. 1	(1,V1,F2)-(2,V1,F2)=0	Const. 15	(1,E1,E1)-(2,E1,E1)=0
Const. 2	(1,V4,F2)-(2,V4,F2)=0	Const. 16	(1,E4,E4)-(2,E4,E4)=0
Const. 3	(1,V5,F2)-(2,V5,F2)=0	Const. 17	(1,E5,E5)-(2,E5,E5)=0
Const. 4	(1,V9,F3)-(2,V9,F3)=0	Const. 18	(1,E7,E7)-(2,E7,E7)=0
Const. 5	(1,V10,F3)-(2,V10,F3)=0	Const. 19	(1,E9,E9)-(2,E9,E9)=0
Const. 6	(1,V11,F3)-(2,V11,F3)=0	Const. 20	(1,E10,E10)-(2,E10,E10)=0
Const. 7	(1,V12,F3)-(2,V12,F3)=0	Const. 21	(1,E11,E11)-(2,E11,E11)=0
Const. 8	(1,V7,F4)-(2,V7,F4)=0	Const. 22	(1,E12,E12)-(2,E12,E12)=0
Const. 9	(1,V18,F4)-(2,V18,F4)=0	Const. 23	(1,E18,E18)-(2,E18,E18)=0
Const. 10	(1,V19,F4)-(2,V19,F4)=0	Const. 24	(1,E19,E19)-(2,E19,E19)=0
Const. 11	(1,V20,F4)-(2,V20,F4)=0	Const. 25	(1,E20,E20)-(2,E20,E20)=0
Const. 12	(1,V22,F5)-(2,V22,F5)=0	Const. 26	(1,E22,E22)-(2,E22,E22)=0
Const. 13	(1,V23,F5)-(2,V23,F5)=0	Const. 27	(1,E23,E23)-(2,E23,E23)=0
Const. 14	(1,V24,F5)-(2,V24,F5)=0	Const. 28	(1,E24,E24)-(2,E24,E24)=0

Table 6.3.6. EDI Versus Internal Systems - Version 1

Goodness of Fit Summary

χ^2 = 173.34 based on 154 d.f. p = 0.136

Bentler-Bonett Normed fit index	= 0.984
Bentler-Bonett Nonnormed fit index	= 0.998
Comparative fit index	= 0.998

	Cumulative Multivariate Statistics				Univariate Increment	
Step	*Parameter*	χ^2	*df*	*Prob.*	χ^2	*Prob.*
1	Const. 16	12.598	1	0.000	12.59	0.000
2	Const. 8	14.074	2	0.001	1.476	0.224
3	Const. 7	15.288	3	0.002	1.214	0.271
4	Const. 15	16.124	4	0.003	0.836	0.361
5	Const. 1	17.390	5	0.004	1.267	0.260
6	Const. 11	18.164	6	0.006	0.773	0.379
7	Const. 24	18.850	7	0.009	0.687	0.407
8	Const. 22	19.488	8	0.012	0.638	0.424
9	Const. 14	20.011	9	0.018	0.523	0.470
10	Const. 12	20.348	10	0.026	0.336	0.562
11	Const. 21	20.583	11	0.038	0.236	0.627
12	Const. 28	20.822	12	0.053	0.239	0.625
13	Const. 17	20.962	13	0.074	0.140	0.708
14	Const. 27	21.135	14	0.098	0.173	0.677
15	Const. 2	21.333	15	0.127	0.197	0.657
16	Const. 25	21.521	16	0.159	0.188	0.664
17	Const. 13	21.671	17	0.198	0.151	0.698
18	Const. 10	21.792	18	0.241	0.120	0.729
19	Const. 26	21.894	19	0.290	0.102	0.749
20	Const. 20	21.953	20	0.343	0.060	0.807
21	Const. 18	22.075	21	0.395	0.122	0.727
22	Const. 23	22.476	22	0.432	0.401	0.527
23	Const. 5	24.347	23	0.385	1.871	0.171
24	Const. 4	28.907	24	0.224	4.559	0.033
25	Const. 19	21.765	25	0.649	7.142	1.000
26	Const. 6	21.879	26	0.695	0.114	0.736
27	Const. 9	21.933	27	0.741	0.054	0.817
28	Const. 3	21.961	28	0.783	0.029	0.866

Table 6.3.7. EDI Versus Internal Systems - Version 2

Goodness of Fit Summary

χ^2 = 182.13 based on 154 d.f. p = 0.060

Bentler-Bonett Normed fit index = 0.990
Bentler-Bonett Nonnormed fit index = 0.998
Comparative fit index = 0.998

	Cumulative Multivariate Statistics				Univariate Increment	
Step	*Parameter*	χ^2	*df*	*Prob.*	χ^2	*Prob.*
1	Constr. 26	3.637	1	0.057	3.637	0.057
2	Constr. 20	6.136	2	0.047	2.499	0.114
3	Constr. 8	8.547	3	0.036	2.412	0.120
4	Constr. 3	10.491	4	0.033	1.944	0.163
5	Constr. 28	12.349	5	0.030	1.858	0.173
6	Constr. 15	13.997	6	0.030	1.648	0.199
7	Constr. 25	15.257	7	0.033	1.260	0.262
8	Constr. 21	16.492	8	0.036	1.235	0.266
9	Constr. 6	17.626	9	0.040	1.134	0.287
10	Constr. 1	18.544	10	0.046	0.917	0.338
11	Constr. 9	19.257	11	0.057	0.714	0.398
12	Constr. 14	19.871	12	0.070	0.613	0.434
13	Constr. 22	20.426	13	0.085	0.555	0.456
14	Constr. 23	20.968	14	0.102	0.542	0.462
15	Constr. 24	21.289	15	0.128	0.321	0.571
16	Constr. 11	21.589	16	0.157	0.300	0.584
17	Constr. 13	21.790	17	0.193	0.201	0.654
18	Constr. 4	21.961	18	0.234	0.172	0.679
19	Constr. 18	22.129	19	0.278	0.168	0.682
20	Constr. 16	22.296	20	0.325	0.166	0.683
21	Constr. 19	22.436	21	0.375	0.140	0.708
22	Constr. 2	22.520	22	0.429	0.084	0.771
23	Constr. 12	22.557	23	0.487	0.037	0.848
24	Constr. 17	22.586	24	0.544	0.029	0.865
25	Constr. 7	22.595	25	0.601	0.008	0.927
26	Constr. 5	22.600	26	0.655	0.006	0.940
27	Constr. 27	22.606	27	0.706	0.006	0.939
28	Constr. 10	22.607	28	0.752	0.001	0.976

Table 6.3.8. EDI Versus Internal Systems - Version 3

Goodness of Fit Summary

χ^2 = 147.75 based on 154 d.f. p = 0.626

Bentler-Bonett Normed fit index	= 0.983
Bentler-Bonett Nonnormed fit index	= 1.000
Comparative fit index	= 1.000

	Cumulative Multivariate Statistics				Univariate Increment	
Step	*Parameter*	χ^2	*df*	*Prob.*	χ^2	*Prob.*
1	Constr. 27	10.768	1	0.001	10.76	0.001
2	Constr. 22	16.453	2	0.000	5.685	0.017
3	Constr. 15	19.799	3	0.000	3.346	0.067
4	Constr. 16	21.904	4	0.000	2.105	0.147
5	Constr. 19	23.767	5	0.000	1.864	0.172
6	Constr. 18	25.817	6	0.000	2.050	0.152
7	Constr. 3	27.963	7	0.000	2.146	0.143
8	Constr. 4	29.834	8	0.000	1.871	0.171
9	Constr. 28	31.456	9	0.000	1.622	0.203
10	Constr. 12	32.848	10	0.000	1.393	0.238
11	Constr. 23	34.029	11	0.000	1.181	0.277
12	Constr. 11	34.933	12	0.000	0.904	0.342
13	Constr. 25	35.851	13	0.001	0.918	0.338
14	Constr. 26	36.781	14	0.001	0.930	0.335
15	Constr. 13	37.473	15	0.001	0.692	0.406
16	Constr. 6	38.178	16	0.001	0.705	0.401
17	Constr. 7	38.769	17	0.002	0.591	0.442
18	Constr. 20	39.403	18	0.003	0.635	0.426
19	Constr. 1	39.834	19	0.003	0.430	0.512
20	Constr. 9	40.228	20	0.005	0.394	0.530
21	Constr. 14	40.568	21	0.006	0.340	0.560
22	Constr. 8	40.857	22	0.009	0.289	0.591
23	Constr. 10	41.102	23	0.012	0.245	0.621
24	Constr. 24	41.602	24	0.014	0.500	0.479
25	Constr. 5	41.817	25	0.019	0.215	0.643
26	Constr. 21	41.971	26	0.025	0.153	0.695
27	Constr. 2	42.000	27	0.033	0.029	0.864
28	Constr. 17	42.003	28	0.043	0.003	0.956

In order to further gain some insight into the importance of variables influencing success of each type of system, the total scores of the rankings of all the variables were also calculated. For each class of system, Table 6.3.9 shows the number of times that each variable has been ranked as one of the top five most important items influencing IS success. For the list of variables, please refer to Section 2.

The algorithm provided in Chapter 5 was used to calculate the total scores of the ranking of each variable. The non-parametric correlation analysis of the rankings of EDI and internal systems resulted in a Kendall correlation of .6200 (p-value = .000). Of the top five most important variables, three variables (Accuracy of output, Reliability of system, and Improvement in customer services) were found to be common to both classes of systems. "Decrease in costs" and "Reduction in paper work" also ranked among the top five important factors of EDI success, while Output reliability and Users' participation were selected for internal systems. These results provided additional evidence that IS success is based on a hierarchical structure, where some generic properties contribute to success of all IS, while some other specific characteristics are perceived to be important in order that the system is deemed successful.

Table 6.3.9. Rankings - EDI and Internal Systems

	E.D.I.						Internal					
Variable	R1	R2	R3	R4	R5	Total	R1	R2	R3	R4	R5	Total
V1	33	30	20	13	15	2495	36	30	26	17	18	2843
V2	5	5	3	6	1	447	12	12	4	15	5	1067
V3	3	8	6	8	3	616	1	6	11	7	6	671
V4	1	5	9	6	3	523	1	8	9	7	5	653
V5	5	14	18	20	16	1578	14	21	22	32	17	2315
V6	3	10	14	11	12	1081	6	8	18	9	20	1313
V7	18	17	18	10	22	1869	29	21	17	14	20	2247
V8	23	22	20	23	20	2381	31	27	20	23	15	2588
V9	3	11	13	18	14	1269	9	12	13	21	18	1579
V10	0	1	1	3	4	188	1	5	1	1	1	202
V11	1	1	2	4	2	215	2	4	3	8	6	494
V12	0	3	3	8	6	423	4	5	14	15	14	1114
V13	9	11	10	12	18	1301	4	5	2	4	9	519
V14	52	29	16	27	12	3074	30	25	12	20	16	2299
V15	2	3	2	3	4	304	1	1	2	0	0	91
V16	3	5	6	1	6	460	0	2	2	0	7	230
V17	11	7	18	9	11	1230	16	8	15	11	3	1189
V18	22	21	21	21	12	2154	14	18	17	15	13	1699
V19	8	16	22	24	25	2048	5	9	18	9	10	1112
V20	7	10	19	13	19	1469	8	12	16	12	21	1492
V21	5	2	5	1	5	397	2	7	8	7	13	792
V22	2	8	3	8	6	586	2	15	8	8	13	997
V23	13	17	3	12	9	1201	33	19	15	21	17	2340
V24	2	3	8	1	10	514	1	8	12	7	15	919
V25	37	9	9	8	11	1681	33	8	10	13	11	1689

4. THE EFFECT OF TIME

The second major research hypothesis related to the instability of IS success across time. Based on the epistemological discussion of success in Chapter 2, we hypothesized that the informational base of the decision maker changes during different stages of the adoption decision process. Two major sources for this change were identified: i) the subject's varying degree of knowledge about the outcomes of the adoption, and ii) the judgemental biases (Fischhoff, 1976; Ajzen and Fishbein, 1977), which affect the decision maker's perceptions of the system's success.

In order to test this hypothesis, the EDI sample was divided according to the stage of adoption of EDI. Those companies that had mentioned that their EDI system was in operation mode were compared with those that did not have an EDI system or were in the process of adopting one. First, tests were performed on independence of EDI stage of adoption and two demographic variables (size and functional area of respondents). The test of independence of EDI stage and functional group yielded a $\chi 2 = 8.84$ ($p = .003$), while the test on independence of EDI stage and size of the firm resulted in a $\chi 2 = 17.16$ ($p = .000$). The results of these two tests indicate that the two samples are not similar along the above two demographic variables. Since we had no control over sampling procedure, it was decided to proceed with two tests related to the instability of IS success across time. First, equality of means of individual variables was tested via t-test. Group 1 (non-adopters) consisted of 151 usable cases, while Group 2 (adopters) contained 160 useable cases.

Table 6.4.1. T-Tests - Adopters Versus Non-Adopters

Var.	*Group*	*Mean*	*S.D.*	*T*	*p-value*
V1	1	4.39	.80	.64	.52
	2	4.33	.84		
V4	1	4.21	.82	.06	.95
	2	4.21	.77		
V5	1	4.32	.82	.33	.74
	2	4.29	.81		
V7	1	3.57	1.00	2.01	.05
	2	3.34	1.04		
V9	1	3.60	.99	-.03	.97
	2	3.60	.99		
V10	1	3.39	1.09	-2.39	.02
	2	3.68	1.05		
V11	1	3.64	1.00	.53	.59
	2	3.58	1.00		
V12	1	3.51	1.10	-1.64	.10
	2	3.71	1.06		
V18	1	3.59	1.01	2.24	.02
	2	3.30	1.18		
V19	1	3.94	1.01	2.85	.00
	2	3.59	1.13		
V20	1	3.92	.92	2.03	.04
	2	3.70	1.04		
V22	1	3.51	1.03	.34	.73
	2	3.47	.97		
V23	1	3.72	1.05	1.57	.12
	2	3.52	1.22		
V24	1	3.76	1.01	2.17	.03
	2	3.51	.95		

As can be seen in Table 6.4.1, all but three of the tests are not significant (two tail test, $p < .025$). These results indicate that means of the majority of the individual variables are significantly different across adopters and non-adopters.

In addition to t-test, the basic model of IS success (Model 1a) was used to perform a two-sample structural analysis of EDI adopters versus non-adopters. As shown in Table 6.4.2, the model fitted very adequately. However, the p-values for all the LM test are below 0.05, indicating that none of the 14 cross-group equality constraints on factor loadings were statistically unlikely to be true in the population.

The above results provide conclusive evidence in support of the hypothesis regarding the role of time in affecting respondents' perceptions of IS success. The shifts in goal hierarchies induced by environmental changes or by the managers themselves call for clear formulation and recalibration of an information system's objectives before, during, and after the system's development. The existing instruments have all relied on the retrospective evaluation of IS by providing only a static snapshot of a system's success, thus ignoring the dynamic nature of the evaluation process.

Our empirical results show that even though all IS share certain generic properties, the weighting of these properties change across time, depending on the implementation stage of the system. Therefore, we call for the continual evaluation of IS over their development life cycle in order to minimize the time-related changes in goal hierarchies of systems.

Table 6.4.2. Adopters Versus Non-Adopters of EDI

Goodness of Fit Summary

χ^2 = 158.69 based on 140 d.f. p = 0.133

Bentler-Bonett Normed fit index = 0.950
Bentler-Bonett Nonnormed fit index = 0.992
Comparative fit index = 0.994

	Cumulative Multivariate Statistics				Univariate Increment	
Step	*Parameter*	χ^2	*df*	*Prob.*	χ^2	*Prob.*
1	Contsr. 5	233.547	1	0.000	233.547	0.000
2	Contsr. 10	536.174	2	0.000	302.627	0.000
3	Contsr. 3	821.549	3	0.000	285.375	0.000
4	Contsr. 13	1125.035	4	0.000	303.487	0.000
5	Contsr. 6	1477.963	5	0.000	352.928	0.000
6	Contsr. 9	1908.847	6	0.000	430.884	0.000
7	Contsr. 7	2382.475	7	0.000	473.628	0.000
8	Contsr. 2	2934.289	8	0.000	551.814	0.000
9	Contsr. 1	4326.757	9	0.000	1392.468	0.000
10	Contsr. 11	5423.075	10	0.000	1096.318	0.000
11	Contsr. 8	6780.646	11	0.000	1357.571	0.000
12	Contsr. 14	7977.649	12	0.000	1197.003	0.000
13	Contsr. 12	11137.942	13	0.000	3160.292	0.000
14	Contsr. 4	11955.449	14	0.000	817.507	0.000

5. THE ROLE OF STAKEHOLDERS

The role of stakeholders in the IS evaluation process has been of some interest in the MIS community. Of particular importance have been the differences between the perceptions of different echelons of management, between subjects with different educational backgrounds, and between people working in different functional areas.

In this section, the hypothesis that different stakeholders view the success of an information systems differently is tested. The overall success of IS services and products will be gauged through the four summary questions of the UIS instrument, while three measures of success as well as their linear composite will be used as proxy for the success of internal systems and EDI systems.

5.1. Management echelon

Differences between the perceptions of different echelons of management in their assessment of IS success were investigated via a series of t-tests of mean differences. A dichotomous question from the survey that solicited information regarding respondents' title was used for this purpose. This comparison was performed for the entire IS services, internal systems, and EDI systems.

The four summary questions of the UIS instrument were used to see whether there are any differences between top executives (Presidents and Vice-presidents) and middle managers (Directors, Managers, Others). No significant differences between top executives and middle managers in terms of satisfaction with their involvement and participation in the ongoing development of information systems were observed. However, significant differences ($\alpha = .10$) were observed in terms of satisfaction with the support and services of the MIS department, with the information product itself, and with the entire information systems environment (Table 6.4.1). A closer examination of data proved that the means of the satisfaction variables are higher among top management than middle management. These findings appear to be in contrast with the general wisdom that the top managers are normally dissatisfied with the overall IS services and products. No differences between the two groups in terms of their evaluation of the success of internal and EDI systems were observed.

Table 6.5.1. Group Differences of UIS - Management Echelon

	Number of Cases	Mean	t-value	p-value
SAT. - INVOLVEMENT				
Group 1	48	5.104	.16	.877
Group 2	317	5.066		
SAT. - MIS DEPT.				
Group 1	47	5.319	1.77	.077
Group 2	316	4.886		
SAT. - IS PRODUCT				
Group 1	48	5.375	1.77	.078
Group 2	316	4.996		
SAT. - ENTIRE IS				
Group 1	48	5.229	1.84	.066
Group 2	317	4.807		

* Group 1: Top Management
Group 2: Middle Management

5.2. Educational Background

In MIS literature, it has long been argued that there are differences between the perceptions of technical and non-technical people (Couger and Zawacki, 1980). To explore this matter, the subjects were divided, according to their educational background, into technical and non-technical groups.

As shown in table 6.5.2, technical people were found to be more satisfied with their involvement and participation in the operation and ongoing development of IS, with the information product itself, and with the entire IS environment. No significant difference was found between technical and non-technical groups in terms of their satisfaction with the support and services of the MIS department. Nor were there any differences between technical and non-technical people in terms of their evaluation of the success of internal or EDI systems.

Table 6.5.2. Group Differences of UIS Success - Educational Background

	Number of Cases	Mean	t-value	p-value
SAT. - INVOLVEMENT				
Group 1	146	5.369	2.85	.005
Group 2	214	4.892		
SAT. - MIS DEPT.				
Group 1	145	5.075	1.20	.230
Group 2	213	4.873		
SAT. - IS PRODUCT				
Group 1	145	5.220	1.84	.067
Group 2	214	4.948		
SAT. - ENTIRE IS				
Group 1	146	5.047	1.92	.055
Group 2	214	4.743		

* Group 1: Technical
Group 2: Non-Technical

We also tested the hypothesis that MIS managers view the success of different types of information systems more favourably than people working in other functional areas of business.

As shown in Table 6.5.3, there is conclusive evidence that MIS managers are far more satisfied with all aspects of information services and products. To a lesser degree, they also view the internal and EDI systems in their company as being more successful than their counterparts in other functional areas. As can be seen in Tables 6.5.4 and 6.5.5, MIS managers perceive the overall success of internal systems (Question 1, Section VII) and attainment of objectives of EDI systems (Question 5, Section VII) to be higher than do other managers.

Table 6.5.3. Group Differences of UIS Success - Functional Area

	Number of Cases	Mean	t-value	p-value
SAT. - INVOLVEMENT				
Group 1	199	5.427	4.83	.000
Group 2	167	4.652		
SAT. - MIS DEPT.				
Group 1	197	5.253	4.18	.000
Group 2	167	4.580		
SAT. - IS PRODUCT				
Group 1	198	5.227	2.70	.007
Group 2	167	4.838		
SAT. - ENTIRE IS				
Group 1	199	5.130	3.79	.000
Group 2	167	4.550		

* Group 1: MIS
Group 2: Non-MIS

Although MIS literature has examined differences between MIS and non-MIS people, these studies by and large have focused on motivational differences between the two groups (Ferrat and Short, 1986; Im and Hartman, 1990).

Our results, on the other hand, provide evidence regarding the perceptual differences between IS and non-IS people, as the former group is certainly more satisfied with the entire IS utility and more favourably predisposed towards the success of certain types of information systems. These findings could be attributed to the fact that technical people are more at ease with the operation and use of information systems services and products than their non-technical counterparts. Another possible explanation for this finding could be that general management attaches more importance to the measurement of IS effectiveness than its IS counterparts (Brancheau and Wetherbe, 1987).[7] Because of the inability of the IS group to provide sound and tangible measures of success, then, general management perceives IS effectiveness less favourably than IS group.

Table 6.5.4. Group Differences of Internal Systems - Functional Area

	Number of Cases	Mean	t-value	p-value
SYSTEMS SUCCESS				
Group 1	191	3.874	1.95	.052
Group 2	155	3.729		

* Group 1: MIS
Group 2: Non-MIS

Table 6.5.5. Group Differences of EDI Success - Functional Area

	Number of Cases	Mean	t-value	p-value
EDI OBJECTIVES				
Group 1	118	3.211	1.66	.098
Group 2	93	3.010		

* Group 1: MIS
Group 2: Non-MIS

[7] Out of 20 key issues, *measuring IS effectiveness* was ranked 4 by general managers and 9 by IS managers.

Taken altogether, the results of these comparative tests provide sufficient evidence that there are perceptual differences regarding IS success among different stakeholders. The findings are also in line with our discussion in Chapter 2 that information systems are purposeful entities, whose goals are not separable from those of human beings assessing them. Therefore, organizations need to explicitly outline the objectives of their IS in order to circumvent the potential biases induced by different stakeholders.

6. EVALUATION FUNCTION

The last research hypothesis related to the multi-dimensionality of IS success. As discussed in Chapter 2, IS literature generally advocates the use of multiple or composite measures of IS success (Weber, 1987), or a set of measures rather than unitary measures (Kauffmann and Weill, 1989).

In light of a lack of concrete theoretical or empirical evidence we decided to explore the association between different types of measurement methods by comparing the relationship between different evaluation functions used as proxy for IS success. In this process, we employed three sets of success measures: i) UIS, ii) single-item measures of success of EDI and internal systems, iii) factors influencing the success of each class of systems.

After these analyses, the correlations between the factors of basic models of IS success, the composite of all variables in the model, and the three single-item measures of success were calculated. These correlations are shown in Table 6.6.1.

Table 6.6.1. Correlations Between Measures of Success

	UIS 1	UIS 2	UIS 3	UIS 4	SUC	OBJ	SAT	F1	F2	F3	F4
						Internal					
UIS 2	.7264**										
UIS 3	.6232**	.6262**									
UIS 4	.7434**	.7280**	.7468**								
SUC	.3066**	.3306**	.3647**	.3771**							
OBJ	.3220**	.2949**	.3526**	.3709**	.5628**						
SAT	.4108**	.4194**	.4511**	.4458**	.6466**	.6604**					
F1	.1878**	.1943**	.1833**	.1960**	.1933**	.2123**	.1620**				
F2	.1696**	.1063*	.1733**	.1244*	.2402**	.2384**	.2353**	.5012**			
F3	.0600	.0807	.1005	.0618	.1586**	.1512**	.1598**	.3725**	.3979**		
F4	.1820**	.1541**	.1735**	.1162*	.0910	.1141*	.1158*	.5139**	.3440**	.3186**	
FF	.1797**	.1723**	.2078**	.1713**	.2422**	.2296**	.2386**	.7256**	.7229**	.7468**	.6406**
						E. D. I.					
UIS 2	.8308**										
UIS 3	.6408**	.6004**									
UIS 4	.7913**	.7955**	.8039**								
SUC	-.0077	.0237	.1274	.1648*							
OBJ	.1208	.1897*	.2813**	.2396**	.5157**						
SAT	.1770*	.2351**	.2892**	.3144**	.5608**	.5182**					
F1	.2028*	.0941	.1566*	.1562*	.2743**	.1094	.1256				
F2	.1275	.0863	.1297	.1254	.3133**	.0051	.1948*	.485**			
F3	.0350	.0025	.0385	.0548	.4248**	.2839**	.2312**	.457**	.3593**		
F4	.1943*	.1090	.1921*	.1998*	.3473**	.1697*	.2266**	.601**	.4813**	.4263**	
FF	.1447	.0658	.1470	.1342	.4597**	.2241**	.2868**	.746**	.7083**	.7978**	.7478**

**	p-value = .01
*	p-value = .05
UIS 1	Satisfaction with involvement in IS development
UIS 2	Satisfaction with support and services of MIS
UIS 3	Satisfaction with information product
UIS 4	Satisfaction with entire IS environment
SUC	Overall degree of success
OBJ	Extent to which objectives attained
SAT	Satisfaction with the system
F1	Output reliability factor
F2	System's characteristics factor
F3	Efficiency outcomes factor
F4	Users' characteristics factor
FF	Linear composite of the four factors in the structural model

As can be seen, there are relatively high correlations among the three single-measures of IS success (ranging from .51 to .66). Correlations between these measures and summary items of the UIS scale (UIS 1 to UIS 4) are also relatively high for internal systems (.29 to .45), but not for EDI systems (.00 to .31).

Further, correlations between the three single-measures and factors constituting the basic model of EDI success (Model 1a) are higher than those for internal systems. This may be attributed to the fact that i) in correlation analysis of EDI systems, only those companies that have already adopted EDI were included, and ii) since over one third of respondents identified themselves as users of EDI, they are in a more objective position to evaluate EDI systems than internal systems.

Overall, correlations between SUC (overall degree of success) and the four factors and their linear composite are higher than those related to the other two single measures (Attainment of Objectives and Satisfaction). This result was anticipated because the evaluation of independent variables related to respondents' perceptions about these variables in influencing *success* of each type systems.

Evidence of convergent and discriminate validity of factors comprising the basic model of IS success (Models 1a and 1b) can be found by comparing the inter- and intra-item correlations among F1 - F4 and UIS 1 - UIS 4. Moreover, we can see relatively high correlations between the three single-measures and the linear composite of the four factors of IS success model (ranging between .23 to .24 for internal systems and .22 to .46 for EDI systems).

In addition to correlation analysis, we performed regression analyses between the variables influencing IS success and the three single measures of IS success (dependent variables).

It should be noted that because of the research design of the study, which required the inclusion of companies that were at different stages of the EDI adoption process, it was not possible to specifically enquire about EDI success factors in an ex-post manner for the whole sample. The responses to the success factors related to the perceptions of respondents about the factors influencing the success of EDI systems in general. The single-item measures (dependent variables), on the other hand, related to the retrospective evaluation of the success of each class of system in the company of respondents. The results of the stepwise regression analyses for internal systems are shown in Tables 6.6.2a - 6.6.4b. As can be seen, because of the above-mentioned problem related to differences in the focus of the independent and dependent variables, only a small number of variables significantly explain the variation in the dependent variables. Of all individual variables, only V4 (Precision of output) is significantly associated with all three single-measures of IS success. The adjusted R square for these three models ranges from .07 to .10. Regression analyses related to the four factors do not improve the explanatory power of the model (R square ranging from .05 to .06), with F2 (System's Characteristics) being the only significant factor among the three models.

Tables 6.6.5a - 6.6.7b show the results of the regression analyses for EDI systems. In contrast to analyses associated with internal systems, these analyses included only companies that have already adopted EDI.

Table 6.6.2a - Regression Analysis - Internal Systems

Dependent Variable: Success
Independent Variables: Individual Variables in Model 1b

Multiple R	.273	ANOVA			
R Square	.074		DF	SS	MS
Adj. R Square	.069	Regression	2	12.367	6.183
Std. Error	.651	Residual	361	153.042	.423
		F = 14.586 Sig. F = .000			

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
V10	.133	.036	.190	3.610	.000
V4	.115	.040	.148	2.817	.005
(Constant)	2.861	.183		15.615	.000

Table 6.6.2b - Regression Analysis - Internal Systems

Dependent Variable: Success
Independent Variables: Factors in Model 1b

Multiple R	.234	ANOVA			
R Square	.055		DF	SS	MS
Adj. R Square	.052	Regression	1	9.099	9.099
Std. Error	.657	Residual	362	156.311	.431
		F = 21.072 Sig. F = .000			

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
F2	.218	.047	.234	4.590	.000
(Constant)	2.993	.180		16.547	.000

Table 6.6.3a - Regression Analysis - Internal Systems

Dependent Variable: Attainment of Objectives
Independent Variables: Individual Variables in Model 1b

Multiple R	.277	ANOVA			
R Square	.077		DF	SS	MS
Adj. R Square	.071	Regression	2	11.992	5.996
Std. Error	.630	Residual	361	143.733	.398

F = 15.061 Sig. F = .000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
V9	.139	.040	.187	3.459	.000
V4	.110	.040	.147	2.722	.006
(Constant)	2.692	.180		14.956	.000

Table 6.6.3b - Regression Analysis - Internal Systems

Dependent Variable: Attainment of Objectives
Independent Variables: Factors in Model 1b

Multiple R	.254	ANOVA			
R Square	.064		DF	SS	MS
Adj. R Square	.059	Regression	2	10.087	5.043
Std. Error	.635	Residual	361	145.627	.403

F = 12.502 Sig. F = .000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
F2	.155	.053	.171	2.916	.003
F1	.107	.052	.120	2.053	.040
(Constant)	2.627	.211		12.455	.000

Table 6.6.4a - Regression Analysis - Internal Systems

Dependent Variable: Satisfaction
Independent Variables: Individual Variables in Model 1b

		ANOVA			
Multiple R	.335				
R Square	.112		DF	SS	MS
Adj. R Square	.100	Regression	5	26.025	5.205
Std. Error	.756	Residual	358	204.891	.572

F = 9.094 Sig. F = .000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
V4	.248	.068	.271	3.637	.000
V10	.116	.044	.141	2.610	.009
V5	-.218	.074	-.221	-2.939	.003
V7	.104	.050	.111	2.078	.038
V9	.101	.051	.111	1.980	.048
(Constant)	2.380	.258		9.199	.000

Table 6.6.4b - Regression Analysis - Internal Systems

Dependent Variable: Satisfaction
Independent Variables: Factors in Model 1b

		ANOVA			
Multiple R	.230				
R Square	.053		DF	SS	MS
Adj. R Square	.050	Regression	1	12.303	12.303
Std. Error	.771	Residual	362	218.613	.603

F = 20.373 Sig. F = .000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
F2	.254	.056	.230	4.514	.000
(Constant)	2.688	.213		12.567	.000

Table 6.6.5a - Regression Analysis - EDI Systems

Dependent Variable: Success
Independent Variables: Individual Variables in Model 1a

Multiple R	.493	ANOVA			
R Square	.243		DF	SS	MS
Adj. R Square	.229	Regression	3	16.290	5.430
Std. Error	.569	Residual	156	50.512	.323

F = 16.770 Sig. F = .000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
V7	.170	.052	.274	3.271	.001
V22	.113	.051	.170	2.205	.028
V19	.102	.047	.178	2.159	.032
(Constant)	2.423	.199		12.166	.000

Table 6.6.5b - Regression Analysis - EDI Systems

Dependent Variable - Success
Independent Variables: Factors in Model 1a

Multiple R	.469	ANOVA			
R Square	.220		DF	SS	MS
Adj. R Square	.210	Regression	2	14.711	7.355
Std. Error	.576	Residual	157	52.091	.331

F = 22.169 Sig. F = .000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
F3	.257	.057	.349	4.485	.000
F4	.145	.057	.197	2.540	.121
(Constant)	2.350	.219		10.697	.000

Table 6.6.6a - Regression Analysis - EDI Systems

Dependent Variable: Attainment of Objectives
Independent Variables: Individual Variables in Model 1a

		ANOVA			
Multiple R	.269				
R Square	.072		DF	SS	MS
Adj. R Square	.066	Regression	1	7.373	7.373
Std. Error	.770	Residual	158	93.849	.593

F = 12.413 Sig. F = .000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
V20	.206	.058	.269	3.523	.000
(Constant)	2.511	.224		11.169	.000

Table 6.6.6b - Regression Analysis - EDI Systems

Dependent Variable: Attainment of Objectives
Independent Variables: Factors in Model 1a

		ANOVA			
Multiple R	.283				
R Square	.080		DF	SS	MS
Adj. R Square	.074	Regression	1	8.122	8.122
Std. Error	.767	Residual	158	93.100	.589

F = 13.785 Sig. F = .000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
F3	.256	.069	.283	3.713	.000
(Constant)	2.379	.248		9.579	.000

Table 6.6.7a - Regression Analysis - EDI Systems

Dependent Variable: Satisfaction
Independent Variables: Individual Variables in Model 1a

Multiple R	.332	ANOVA			
R Square	.110		DF	SS	MS
Adj. R Square	.099	Regression	2	10.197	5.098
Std. Error	.772	Residual	157	82.057	.522

F = 9.755 Sig. F = .000

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
V12	.165	.057	.230	2.877	.004
V20	.125	.058	.171	2.142	.033
(Constant)	2.501	.252		9.919	.000

Table 6.6.7b - Regression Analysis - EDI Systems

Dependent Variable: Satisfaction
Independent Variables: Factors in Model 1a

Multiple R	.230	ANOVA			
R Square	.053		DF	SS	MS
Adj. R Square	.047	Regression	1	4.911	4.911
Std. Error	.743	Residual	158	87.343	.552

F = 8.884 Sig. F = .003

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
F3	.199	.066	.230	2.981	.003
(Constant)	2.884	.240		11.987	.000

Although the adjusted R squares of models related to two of the dependent variables (Attainment of Objectives and Satisfaction) are low (.047 to .099), the adjusted R squares of the two models related to the other dependent variable (Success) are relatively high (.220 and .229).

In spite of the methodological difficulty related to research design, evidence of the multi-dimensionality of IS success can be found from the results of the correlation analyses. As shown in Table 6.6.1, correlations between the three measures of IS success and the linear composite of the four factors constituting the basic IS success model are almost all larger than correlations between these three measures and each of the four individual factors constituting IS success.

In Chapter 2, we maintained that the major shortcoming of a single criterion is the choice of proper criteria for performance measurement (Ridgway, 1956). Further, we stated that the risk associated with this type of measurement is that it ignores important goals and constraints. In the absence of a single measure of IS success, therefore, a structural model such as the one developed in this study will allow the operationalization of the individual's conception of the hierarchy among the multiple criteria of IS success. The results presented above indicate that multiple factors together explain a higher percentage of the variation in the single-item proxy measures for IS success than does each individual factor.

Based on our previous epistemological discussion of IS success in addition to the empirical results of this study, there is conclusive evidence that the concept of IS success is a multi-dimensional construct. What is not yet clear is how different dimensions of the construct are inter-related, and what are the relative degrees of importance of each dimension in explaining the variation in the success of IS. This is an area of research that is fertile for exploration.

7. SUMMARY

This chapter provided the empirical results of the research study. First, using linear structural modelling techniques, it was found that IS success is composed of four generic factors (Output Reliability, System's Characteristics, Efficiency Outcomes, and Users' Requirements). Evidence regarding the invariance of the key parameters of this basic model of IS success across different classes of systems, as well as the overall goodness of fit of the model was provided. In addition to the generic factors, it was found that the success of EDI systems is also influenced by a specific factor related to inter-corporate outcomes.

An examination of the rankings of variables further confirmed that IS success is influenced by certain generic properties common to all classes of information systems, as well as certain properties specific to each class of systems. Altogether, these results provided sufficient evidence to confirm the hierarchical nature of information systems success.

The second research hypothesis related to the instability of IS success across time. This hypothesis was tested by examining the invariance of the key parameters of the basic model of IS success across firms that have adopted EDI and those that have not adopted EDI or are in the process of adopting it. A two-sample analysis of data yielded a statistically adequate model. However, the cross-group equality of key parameters was found to be statistically unlikely true, thus providing evidence in support of the second research hypothesis.

The third hypothesis relating to the role of stakeholders in the adoption process was tested by comparing the perceptual differences between different echelons of management, between subjects with different educational background, and between people working in different functional areas. It was found that top managers are generally more satisfied with the IS utility than middle managers. It was speculated that since middle managers' jobs are more directly affected by the activities of the MIS department, they are more discerning in their evaluation of the IS environment than top managers. Besides management echelon, we also found differences between IS and non-IS people in terms of their satisfaction with the IS utility. The results of this study by and large point to perceptual differences between different management echelons and between technical and non-technical people. Since the evidence in the MIS literature is fragmentary in these areas, we call for additional research to shed further light on perceptual differences attributable to management echelon and background.

The last hypothesis pertaining to the multi-dimensionality of IS success was tested by correlating various measures including UIS, single-item measures, and multiple-item measures. Specifically, the four summary variables measuring respondents' overall satisfaction were correlated with overall measures of EDI and internal systems' success. In general, correlations between the single-item measures of IS success and the linear composite of all variables were found to be larger than the correlations between these measures and the individual success factors. This provided support for the hypothesis that IS success is a multi-dimensional construct. In view of lack of empirical evidence regarding the inter-relationship among various factors constituting IS success, we called for further research in this area.

CHAPTER 7 - FUTURE RESEARCH

In the previous chapter, the major research findings were presented. In this chapter, several corollaries that have important implications for IS research will be examined. Some of these corollaries have been treated in other contexts in the IS literature, while others have received little or no attention.

The chapter is divided into three parts. First, the role of users' involvement in successful implementation of IS will be discussed. Second, the concept of IS success will be further explicated in the realm of the moderating effect of the firm's size. Finally, the methodological issues pertaining to the effect of ordering of questions on responses will be discussed.

1. USERS' INVOLVEMENT

As discussed in Chapter 2, in addition to the persuasion stage, attitude formation takes place in the confirmation stage of the adoption decision process when the adopters re-evaluate their attitude towards the innovation depending upon the correspondence between their prior expectations and the actual outcomes of the innovation. Potential changes could be anticipated if the total informational base underlying the attitude (Fishbein and Ajzen, 1975, p. 400) were altered in the period between the persuasion and confirmation stages. A potential source of change in the decision maker's informational base is the knowledge of the outcomes of the innovation, which is a correlate of temporal setting (Fischhoff, 1976). Another important source of attitude change is active participation, which is assumed to provide the actor with an opportunity to acquire new information ((Fishbein and Ajzen, 1975, p.411).

In light of this, it was hypothesized that greater degrees of familiarity with and involvement in a particular information system project will lead to a more favourable attitude towards the success of that project. In this study, the role of involvement and familiarity in changing the perceptions of respondents was studied through the inclusion of two questions in the survey. Both of these questions were based on 5-point Likert scales. The first question (Section II, Question 5 of the questionnaire) solicited information about the extent of respondents' familiarity with EDI systems. Those who mentioned that they were "Highly familiar" or "Moderately familiar" with EDI systems were clustered into one group, while those who maintained that they were "A little familiar," or "Not familiar at all" were categorized in another group. Because of the very low number of respondents in the latter group (4), those who had mentioned that they were "Somewhat familiar" were also clustered in this group. A comparative examination of the evaluation of IS success between these two groups is shown in Table 7.1.1. As can be seen, overall IS success is viewed differently by the "Familiar" and "Unfamiliar" groups, based on their evaluation of the overall success of the system, the extent to which the system has achieved its objectives, and their satisfaction with the system, as well as the linear composite of these variables.

The second question (Section II, Question 6 of the questionnaire) enquired about the extent to which respondents have been involved in the EDI project in their firms. The "Very involved" and "Moderately involved" were grouped together, while those who had mentioned that they were "Somewhat involved," "Little involved," or "Not involved at all" were clustered into another group. As in the previous analysis, we could not delete the middle category because of the low number of respondents in the "Not involved" group.

Table 7.1.1. Group Differences of EDI Success - Familiarity

	Number of Cases	Mean	t-value	p-value
EDI SUCCESS				
Group 1	183	3.639	2.31	.022
Group 2	27	3.296		
EDI OBJECTIVES				
Group 1	183	3.174	2.21	.028
Group 2	28	2.785		
EDI SATISFACTION				
Group 1	183	3.480	2.30	.023
Group 2	28	3.107		
OVERALL SUCCESS				
Group 1	184	3.422	2.61	.010
Group 2	28	3.053		

* Group 1: Familiar
Group 2: Not Familiar

As shown in Table 7.1.2, there are significant differences between those who have and those who have not been involved in the EDI project. These findings are congruent with those of Montazemi (1988) who, based on the original UIS instrument, found that end users' satisfaction is positively affected by their involvement in the development process. Using a path analysis of user involvement and successful system design and implementation, Tait and Vessey (1988) also found that user involvement has a positive effect on system success. Tait and Vessey could not provide conclusive evidence regarding the significance of the involvement-success relationship because data for their study was based on ex-post evaluation of systems under study. Our data, on the other hand, included firms that were in various stages of EDI adoption.

Table 7.1.2. Group Differences of EDI Success - Involvement

	Number of Cases	Mean	t-value	p-value
EDI OBJECTIVES				
Group 1	184	3.184	2.06	.058
Group 2	24	2.833		
EDI SATISFACTION				
Group 1	184	3.510	2.06	.000
Group 2	24	2.833		
OVERALL SUCCESS				
Group 1	184	3.442	2.06	.004
Group 2	24	3.013		

* Group 1: Involved
Group 2: Not Involved

In order to test the interaction effects of the stage of adoption and the extent of involvement on EDI success, a 2x2 two-way analysis of variance was performed. The first main effect included the two groups of "Involved" and "Not involved", while the second main effect included firms that have already adopted EDI (Adopted) and those that are in process of adopting it (In process). The dependent variable was computed by taking the average of the three single-item measures of EDI success (Section VI, Questions 4-6 of the questionnaire). Table 7.1.3 shows the means and counts of success scores for each cell as defined by level of involvement and stage of adoption.

Table 7.1.3. Mean Success Scores

		Involvement	
		Involved	Not involved
Stage of Adoption	In process	2.69 (39)	3.00 (8)
	Adopted	3.58 (142)	3.11 (15)

As shown in Table 7.1.4, significant differences between the "Involved" and "Not involved" groups, as well as between the "Adopted" and "In process" groups were observed. The p-value of the F-test related to the existence of interaction is below .10, indicating that the hypothesis that there is no interaction between the two independent variables can be rejected only at $\alpha = .10$.

Altogether, the results of these analyses provided evidence that involvement has positive effect on respondents' evaluation of IS success. It was also shown that the subjects' responses may be influenced by the ultimate success or failure of the system, as success is viewed differently in firms that have adopted EDI or are in the process of adopting it. In other words, we found some weak evidence that the interaction effects between involvement and stage of adoption are not very large.

Table 7.1.4. Overall EDI Success by Involvement and Stage of Adoption

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Main Effects	13.577	2	6.788	17.788	.000
Stage of Adoption	10.692	1	10.692	28.017	.000
Involvement	1.863	1	1.863	4.882	.028
2-way Interactions	1.157	1	1.157	3.032	.083
Inv. Adopt.	1.157	1	1.157	3.032	.083
Explained	14.734	3	4.911	12.869	.000
Residual	76.326	200	.382		
Total	91.060	203	.449		

As a corollary to this hypothesis, it was decided to test whether users view the success of the EDI system in their firm more favourably than non-users. For this purpose, we used the question that asked respondents whether or not they classify themselves as a user of EDI. Table 7.1.5 shows the results of these tests, which are all significant at α = .05. These findings should be interpreted with care, however, without drawing any causal inferences. In particular, it should be noted that use by itself cannot lead to the success of a system, especially when use is not optional (Lucas, 1978; Robey, 1979). A potential explanation for this finding, nonetheless, could be that since EDI systems are relatively easy to use, active participation and use provide the users with an opportunity to acquire new information about the adopted system, thus leading to a change in their informational base.

Table 7.1.5. Group Differences of EDI Success - Use

	Number of Cases	Mean	t-value	p-value
EDI SUCCESS				
Group 1	107	3.691	1.97	.050
Group 2	103	3.495		
EDI OBJECTIVES				
Group 1	108	3.287	2.83	.005
Group 2	103	2.951		
EDI SATISFACTION				
Group 1	108	3.546	2.13	.034
Group 2	103	3.310		
OVERALL SUCCESS				
Group 1	108	3.504	2.80	.006
Group 2	104	3.237		

* Group 1: Users
Group 2: Non-Users

2. THE SIZE OF THE FIRM

Using annual sales as a surrogate measure of firm size, potential differences between the perceptions of respondents in large firms and those in small companies were explored. The firms were classified according to their annual sales into three groups: i) small companies, with sales less $100 m., ii) large companies with sales between $100 m. and $1 b., and iii) very large companies, with sales exceeding $1 b.

Table 7.2.1. Group Difference of UIS 1 - Size

Source	Sum of Squares	DF	Mean Squares	F Ratio	F Prob.
Between Groups	19.068	2	9.534	4.004	.019
Within Groups	776.153	326	2.380		
Total	795.221	328			
CONTRASTS	T-Value	DF	T Prob.		
Contrast G1-G2	1.875	326	.062		
Contrast G1-G3	2.733	326	.007		
Contrast G2-G3	.750	326	.454		

* Group 1: Small companies
Group 2: Large companies
Group 3: Very large companies

A one-way ANOVA of all four summary questions of UIS based on these three groups was performed. The results indicated that respondents in small companies are more satisfied with the support and services of the MIS department (UIS 2) than their counterparts in larger companies (Table 7.2.1). No significant differences regarding the other three summary questions of UIS were found. Nor there were any significant differences among companies of different size regarding their evaluation of success of EDI or internal systems.

3. QUESTION ORDER

As mentioned previously, each of the three different versions of the questionnaire anchored the response of the subjects with a different item related to the IS success factors. Pairwise comparison of the three versions of the questionnaire was made to see if question order has any significant effect on the basic structural model of IS success. Equality of key parameters of the two-sample cross-version models was tested by imposing constraints related to equality of factor loadings and unique or error terms. It was hypothesized that if there is no response effect, a) the two-sample models would yield an acceptable χ^2 goodness of fit, and b) all the constraints pertaining to the equality of key parameters would be true.

Tables 7.3.1 and 7.3.2 show the summary of two-sample analyses of the different versions of the questionnaire for EDI and internal systems, respectively. All but one of these cross-version models yielded acceptable χ^2 goodness of fit. However, based on the LM tests, constraints related to the equality of factor loadings and error terms of five of the comparative models were statistically unlikely to be true.

These results indicated that even though the pairwise versions of the questionnaire yield statistically acceptable models of IS success, the key parameters in the models are not all invariant. Since the questionnaires were identical in all aspects except the ordering of the items, these results provided some evidence regarding the effect of question order on responses.

In order to further explore this methodological issue, the rankings of the success factors for the three versions were also compared. Table 7.3.3 shows that the pairwise Kendall correlations analyses of the rankings of the items of the three versions of EDI and internal systems resulted in correlations ranging from .69 to .80.

Table 7.3.1 Two-Sample Analyses - Internal Systems

VERSION	χ^2	p-value	Fit Indices	Inadequate Constraints
V1 - V2	168.70	.197	BB1 = .988	V7, E4
			BB2 = .999	
			CI = .999	
V1 -V3	164.95	.258	BB1 = .985	E1, E23
			BB2 = .999	
			CI = .999	
V2 -V3	176.99	.098	BB1 = .988	V10, V24, E4, E10
			BB2 = .998	
			CI = .998	

* BB1 = Bentler-Bonett Normed fit index
BB1 = Bentler-Bonett Nonnormed fit index
CI = Comparative fit index

Table 7.3.2 Two-Sample Analyses - EDI Systems

VERSION	χ^2	p-value	Fit Indices	Inadequate Constraints
V1 - V2	203.22	.004	BB1 = .987	E11
			BB2 = .996	
			CI = .997	
V1 -V3	146.55	.652	BB1 = .983	V4
			BB2 = 1.000	
			CI = 1.000	
V2 -V3	170.36	.173	BB1 = .990	
			BB2 = .999	
			CI = .999	

* BB1 = Bentler-Bonett Normed fit index
BB1 = Bentler-Bonett Nonnormed fit index
CI = Comparative fit index

Table 7.3.3. Pairwise Kendall Correlations of Rankings

E D I	Internal
r_{v1v2} = .793	r_{v1v2} = .700
r_{v1v3} = .740	r_{v1v3} = .800
r_{v2v3} = .693	r_{v2v3} = .726

* p-value = .000

Furthermore, it was found that respondents to each version of the questionnaire ranked the top five most important items differently, thus providing additional evidence regarding the potential effect of question order on responses (Table 7.3.4).

Table 7.3.4 The top most important items

	E. D. I.				Internal			
RANK	VER1	VER2	VER3	ALL	VER1	VER2	VER3	ALL
1	V_{14}	V_{14}	V_8	V_{14}	V_1	V_8	V_1	V_1
2	V_1	V_{18}	V_{14}	V_1	V_5	V_7	V_8	V_8
3	V_{18}	V_{19}	V_1	V_8	V_{23}	V_{14}	V_{23}	V_{23}
4	V_8	V_{25}	V_{18}	V_{18}	V_8	V_{23}	V_{14}	V_5
5	V_{19}	V_1	V_{19}	V_{19}	V_{14}	V_1	V_5	V_{14}

4. SUMMARY

In this chapter, a) the effect of several contextual variables on the dependent variable were examined and b) the implications of some methodological issues for survey research were explored. First, it was shown that the evaluation of IS success is influenced by the users' familiarity with the system and by their involvement in the development of the system. Our comparison of firms that have already adopted EDI with those that are in the process of adopting it also indicates that a system's success is perceived and evaluated differently by these two groups. Furthermore, users of EDI were found to be more favourable in terms of their evaluation of the system's success. The quality of the system was thought to be a potential factor causing these differences.

Second, our comparative examination of potential differences between respondents' perceptions of IS success in firms of different size indicated that respondents in smaller firms are more satisfied with their IS environment than their counterparts in larger companies.

Finally, the effect of question order on responses was explored. It was shown that question order may affect the way respondents answer a battery of related questions. Since there is no general theory regarding the detection and avoidance of response effects, researchers conducting surveys are cautioned to carry out experiments to determine empirically the size and direction of such effects.

CHAPTER 8 - SUMMARY AND CONCLUSIONS

> MIS is identifiable only in terms of a meaningful concept of information and effectiveness ...
>
> (Keen, 1980, p.18)

Because IS research is predicated on the basic premise that information systems change the way individuals, units, and organizations achieve their objectives, in this dissertation attempts were made to explicate the meaning of the concept of IS success. In Chapter 2, our review of the literature revealed that measuring changes brought about by the introduction of information technology is a complicated task that needs to take into account i) the constituency and the type of the system that is being assessed, ii) the time frame of the study, and iii) the efficacy of different types of evaluation functions used in the assessment process. It was argued that successful objects are goal-oriented, and that their evaluation is attitude and time dependent. Subsequently, we showed that an information system's success is a function of i) the system's characteristics, which is the ability to achieve certain performance benchmarks in terms of storing, processing, and transmitting information in a given time interval, and ii) the system's quality, which is the degree of correspondence between certain real-world states and the representation of these states by the system. The other constituent of the capability dimension, cost, represented an efficiency measure of economic performance of the system. In view of the complexities involved in the IS assessment process, we called for a careful circumscription of the construct of IS success in order to diminish some of the conceptual and definitional ambiguities. In particular, we contended that the effects of systems type, temporal context, and users' characteristics should be accounted for in the assessment of IS success (Hawgood and Land, 1988; Venkatraman and Zaheer, 1989; Melone, 1990). In order to diminish some of the existing methodological problems, we also called for inter-group comparison (Lucas, 1975), as well as cross-sectional examination of firms that have or have not invested in a specific technology (Kauffmann and Weill, 1989).

Our epistemological treatment of the concept of IS success and coverage of the pertinent conceptual and methodological issues culminated in two major hypotheses: i) the success of different types of IS share certain structural properties, and ii) the decision maker's perceptions of a system's success change during various stages of the adoption process. In addition, we postulated that perceptions of a system's success are different among different groups of stakeholders.

Since none of the existing categories of outcome variables of IS success sufficiently captures its full meaning, an operational definition for IS success as well as a hierarchical structural model of IS success was proposed in Chapter 3. The basic properties of successful systems were identified in order to explain the inherent behaviour of such systems. It was shown that the success of information systems is composed of two basic types of properties: i) those generic properties that are shared by all systems, and ii) those that are specific to a particular type or class of IS. One of the major problems surrounding IS success literature relates to the inability of researchers to isolate the factors constituting the deep structure of successful IS from those constituting their surface structure (Weber, 1987). We divided information systems into two broad categories of internal and external systems. It was shown that the principal factor demarcating the domain of these two classes of IS encompasses variables related to the external environment of the organization. The success of external IS, we maintained, is differentiated from that of their internal counterparts because of the structural differences between these two classes of systems. We contended that while internal systems are adopted to support internal operations, management, and decision making in the organization, external systems are implemented to improve the bargaining power or comparative efficiency of the firm (Johnston and Vitale, 1988). In spite of these differences caused by the specificities of surface structure, we argued that all information systems share a deep structure consisting of four dimensions (Output Quality, System's Characteristics, Efficiency Outcomes, and User Characteristics). This epistemological treatment of IS success and the subsequent operationalization of the construct is believed to have set a theoretical framework for examination of the structural properties of IS success, as well as the factors underlying this construct.

In Chapter 4, we examined the concept of time as it relates to the assessment of information systems success. Using the diffusion theory, the five stages of the innovation decision adoption process were examined, and subsequently a model of information technology adoption and assessment process was developed. In laying out the theoretical groundwork of this model, we directed particular attention to the role of attitude formation/confirmation during various stages of the adoption process.

Then, we discussed various sources of attitude change in order to set the conceptual basis for the examination of dissonance as a source of attitude change. In addition, we reviewed the roles of knowledge of the outcomes of a decision and the individual's direct experience in the process of attitude change. Since biases related to information acquisition, processing, and use influence the decision maker's judgement and attitudes, we also listed these limitations and biases. Finally, we examined various conceptual and methodological issues surrounding measurement of change. The implications of these problems for the study of information technology adoption process were highlighted.

Chapter 5 focused on research design and related methodological issues. It was shown that in attitudinal studies the measurement is not of the phenomenon directly, but of behaviours that are conceptualized as their indicators (Bradburn, 1983, pp. 289-293). Since researchers might disagree as to which measurement is more nearly true, it is not then possible to claim that the true value of a construct has been measured. At best, we can agree on the amount of response effect that different methods of data collection produce.

The questionnaire design and scale development processes were based on the guidelines suggested in the literature. Non-response bias was examined through a multiple-stage surveying method, while the response effect was investigated by employing different types of scale and different ordering of questions.

Apart from various demographic characteristics of the responding firms and respondents, different aspects of the EDI program in the adopting firms were also highlighted. The effect of non-response bias was tested based on characteristics of the respondents and organizations participating in the survey.

In Chapter 6, the empirical results of the research study were presented. Using linear structural modelling techniques, the relationships between factors constituting IS success and their corresponding variables were tested based on second-order and hierarchical structural models. In the former model, it was hypothesized that, irrespective of the type of the system, IS success generates the covariance of four correlated factors (1. output quality, 2. system's characteristics, 3. system's outcomes, 4. user characteristics). None of the second-order models resulted in adequate fit, and therefore were dropped. In the hierarchical model, on the other hand, we assumed that IS success is composed of five uncorrelated factors, of which the first factor is general and the other four are independent clusters. It was shown that the generic properties of successful information systems can be operationalized through a hierarchical structural model constituting four generic factors and a general factor. Evidence regarding the invariance of the key parameters of this basic model of IS success across different classes of systems, as well as the overall goodness of fit of the model, was provided. In addition to the four generic factors, it was verified that the success of EDI systems is also influenced by a three-item factor specifically related to inter-corporate outcomes. An examination of the rankings of variables further confirmed that IS success is influenced by certain generic properties common to all classes of information systems, as well as certain properties specific to each class of systems. Altogether, these results provided sufficient evidence to confirm the hierarchical nature of information systems success, thus supporting the first research hypothesis.

The second research hypothesis related to the instability of IS success across time. The invariance of the key parameters of the basic model of IS success across i) firms that have adopted EDI and ii) those that have not adopted EDI, or are in the process of adopting it, was tested using a two-sample analysis of data. Although a statistically adequate model was fitted to data, the cross-group equality of key parameters was found to be statistically unlikely true. This result corroborated the evidence in psychology (Fischhcoff, 1976) that the knowledge of the outcome of an innovation is a correlate of temporal setting and a source of attitude change. Based on these results we called for a closer examination of the role that time plays in changing the assessor's perceptions over time.

The third hypothesis, relating to the role of stakeholders in the adoption process, was tested by comparing the perceptual differences between different echelons of management, between subjects with different educational background, and between people working in different functional areas. It was found that top managers are generally more satisfied than middle managers with the entire IS environment. It was speculated that since middle managers' jobs are more directly affected by the activities of the MIS department, they are more discerning than top managers in their evaluation of the IS environment. Besides management echelon, we also discovered differences between IS and non-IS people in terms of their satisfaction with the IS environment. Two possible explanations for these difference were presented: i) that technical people perceive the IS environment and specific classes of IS more favourably because they are more at ease with the operation of information systems and ii) that general management is more discerning in its evaluation of IS because it attaches more importance to IS evaluation than IS management (Brancheau and Wetherbe, 1987). In view of the rather fragmentary treatment of these issues in MIS literature, we called for further research on perceptual differences attributable to management echelon and background.

The last hypothesis, pertaining to the multi-dimensionality of IS success, was tested by using the basic structural model of IS success in addition to correlations between various measures including UIS, single-item measures, and multiple-item measures. In general, correlations between the single-item measures of IS success and the linear composite of all variables were found to be larger than the correlations between these measures and the individual success factors. Furthermore, the adequacy of the basic structural of model of IS success provided additional evidence regarding the multi-dimensionality of IS success.

In Chapter 7, some corollaries that have important implications for IS success evaluation were examined. In addition, the significance of some important methodological issues for survey research was explored. More specifically, it was shown that the evaluation of IS success is influenced by the users' familiarity with the system and by their involvement in the development of the system. Users of EDI were also found to be more favourable in terms of their evaluation of the system's success. These results confirmed the pertinent theories in organizational behaviour

(Fishbein and Ajzen, 1975, p.411) that active participation provides the actor with an opportunity to acquire new information, thus changing the decision maker's informational base.

The effect of question order on responses was also explored. It was shown that question order may affect the way respondents answer a number of related questions. In light of the absence of a general theory regarding the detection and avoidance of response effects, researchers conducting surveys were cautioned to carry out experiments to determine empirically the size and direction of such effects (Bradburn, 1983, p. 303).

1. LIMITATIONS

We faced several conceptual and methodological difficulties throughout this dissertation. First, the results of the empirical study were found to be incongruent with the evidence in MIS literature. We relied on pertinent theories in philosophy of science, psychology, diffusion of innovation, and organizational theory to identify the basic properties of successful systems. These basic properties were subsequently incorporated into a hierarchical structural model. Four hypotheses related to these properties were postulated and then empirically tested. Statistical analyses of the data, in turn, provided sufficient evidence in support of the research hypotheses. These findings, however, were found to be in contrast with the evidence in MIS literature.

One possible explanation for this state of affairs is that the MIS field has been faced with fragmentation and lack of cumulative tradition because of the endless succession of transient topics (Teng and Galletta, 1991). Not surprisingly, the empirical studies on IS success have produced inconclusive results because of the lack of articulated theories in the area of IS success assessment.

Another explanation for this academic deadlock lies in the epistemological nature of scientific inquiry. From a philosophic scientific point of view, we tend to rely on two broad standards when evaluating a model (Bollen, 1989). We seek to test whether the model is consistent with data. Or, we check whether the model is consistent with the "real world". Most statistical techniques, including structural equation techniques, explicitly test for the former, but seldom check for the latter. As was done in this study, the model-data consistency is checked i) by comparing relations predicted by a model with those present in the data, or ii) by comparing the magnitude, sign, and statistical significance of parameter estimates with those hypothesized in the model. Model-reality consistency, in contrast, is not easily possible because it implies or requires as an antecedent condition perfect knowledge of the "real" world with which to evaluate the model. Therefore, it is misleading to use model-data consistency to infer model-reality consistency, as the former is only a necessary, but not sufficient, condition for the latter. In this context, statistical techniques are powerful tools in rejecting models that are inconsistent with the data, and therefore detecting model-reality gaps. These techniques, however, are unable to test for model-reality consistency because the true model is only one of many that might match the data. In light of this academic impasse, model-reality consistency is evaluated in an imperfect manner. We either compare "the predictions implied by a model to those observed in the context different from the data that supply the model parameter estimates...", or "examine the assumptions and relations embedded in a model and debate their validity based on other experiences or insights" (Bollen, 1989, p. 68). Needless to say, neither of these approaches will provide full evidence in ascertaining model-reality consistency, because empirical methodologies can never prove a model to be true; they can only reject a model.

In spite of the above impasse, we can generate well-grounded theories by relying on the interplay between deductive and inductive methods of inquiry. According to the falsification perspective advocated by Propper (1959), a scientific discipline advances by testing and comparing models to data and determining which models are fittest to survive academic scrutiny. We need to take a "quasi-inductive" approach in terms of degree of testability and corroborability of our theories; discoveries should be guided by theories, rather than vice-versa. Models not discarded by failing data tests are those closest to the true one.

The second limitation of the study was associated with the instability of time in the IS success assessment process. We gathered cross-sectional data of perceptions of two groups at two different stages of EDI adoption in order to show that the decision maker's perception of a system's success changes over time. A controlled longitudinal study where perceptions of decision makers are followed and observed over time would provide more conclusive evidence regarding the role that time plays in the adoption and assessment process. Moreover, a matched-pairs design methodology would remove the potential confounding effect of differences caused by contextual variables such as characteristics of the firm or decision maker. In addition, since computational problems during optimization of linear structural equations are inversely related to sample size (Bentler, 1989, p. 6), larger samples would potentially provide more accurate estimates of the structural model of IS success.

The third limitation of the study related to the instability of the basis of measurement of IS success. Our epistemological treatment of the concept of success led to the conclusion that because of changes in either the system's goals or in the weighting of certain goals, the basis of measurement of success is unstable. Moreover, we argued that the most appropriate methodology for measuring IS success is to compare a system's actual performance with the original goals for which the system was designed. Our review of the MIS literature, however, showed that the instability of the basis of measurement has seldom been accounted for in the IS evaluation research. Because of the particular orientation of this dissertation, we did not test for this instability either. Instead, we examined the hierarchical nature of IS success, as well as its instability across time and attitudes. A fruitful direction for future research is to design studies that would trace a system's behaviour over time and compare its ultimate performance against the original goals for which the system is designed.

Fourth, we faced a limitation relating to the generalizability of our findings. In the empirical part of the study, we used EDI to represent external systems. This, in turn, seriously attenuated the generalizability of our findings because EDI is only one specific type of interorganizational information system. In light of the early stage of theory development in the area of IS assessment, however, this research method was deemed appropriate. At a minimum, by employing a case study of one specific type of system, we controlled for certain factors which could have potentially confounded the results of the study. By controlling for systems-related factors, we were able to draw a more accurate map of the key variables that appear to influence the phenomenon under study. This methodology could consequently lead to tests aimed at determining the extent of the domain to which pertinent hypotheses apply (Schendel & Hofer, 1979). Focusing on other types of IOS in order to enhance generalizability of the findings of this study appears to be a fruitful direction.

Finally, the results of the study should be interpreted in the realm of the common shortcomings surrounding surveys. Particularly, since the effects of the survey operations on survey results are not usually known, it is possible that factors that are still unknown condition the effect of survey procedure on survey data. More importantly, because biases change over time and are related to and confounded by the state of reality we are trying to measure, the true change is potentially confounded by systematic changes in the sources of bias in survey measurement (Martin, 1983, p. 729). Unfortunately, this leave us in an academic quandary because we cannot develop substantive theories in the absence of good data. We believe that progress of science is possible only through a dynamic interplay between articulated theories and techniques of measurement. Therefore it is of great importance to understand the sources of survey artifacts before we can adequately estimate and correct for biases they introduce in measurements of change.

We attempted to attenuate the effects of these problems by following the guidelines suggested in the literature (Martin, 1983, p.730) in the design and construction of survey instrument. Specifically, we provided new baseline data by using the existing instruments as well as new measures. This strategy allowed us to provide empirical evidence in support of theoretical concerns regarding the difficulties associated with the existing instruments measuring IS success.

2. CONTRIBUTION

This dissertation has made a contribution to MIS literature both conceptually and methodologically. Using the literature on philosophy of science and organizational theory, the domain of the concept of IS success has been demarcated. The theoretical groundwork laid out in Chapter 2 highlighted the generic properties of successful systems. Our review of MIS literature, on the other hand, showed that these properties have not generally been accounted for in the IS evaluation research.

The conceptual foundation as well as the empirical results of this study have significant implications for both practitioners and academics. First, by explicating the domain of IS success, practitioners will be able to plan for IS adoptions more thoughtfully, and assess the success of existing IS more accurately. An understanding of how information systems solidify the existing intra- and inter-organizational relations will ultimately result in improved comparative efficiency and competitive position of the firm.

Second, the dissertation has methodological as well as theoretical significance for researchers. Conceptually, given the comprehensive coverage of information processing biases in other academic disciplines, great value will be gained from anchoring the study of information systems adoption in this body of literature. Our comparative study of organizations which are in the pre- and post-implementation stages of adopting a new technology has enhanced our understanding of the *process* of information systems assessment. Since the results of the study point to changes in the decision maker's perceptions at different stages of the adoption process, we need to reassess the validity of the existing measuring instruments of IS success which are all based on ex-post surveys. Furthermore, because the results show that the success of external systems is assessed differently from that of internal systems, we need to focus our attention on developing evaluative measures for specific types of information systems.

Methodologically, we showed that question order has some effect on responses. As Bradburn (1983, p. 302) has stated, "no topic in questionnaire construction is more vexing or resistant to easy generalization than that of question order." Several sources might produce response effect including i) saliency of particular topics, ii) overlap in content between sections, iii) influence of earlier judgements on later ones, iv) overall position of questions in the questionnaire, and v) hesitancy of respondents to answer sensitive questions at the beginning of the questionnaire (Bradburn, 1983, pp. 303-304). In light of the effect of these sources on responses and in view of the fact that there is no general theory related to question order, we call for further examination of these sources and their effects on data obtained via surveys.

Apart from these immediate contributions, the dissertation has shed some light on certain important issues associated with the adoption and assessment of information technology. Even though some of the findings of the study are tentative, they provide important research directions for the future. In particular, we call for further research in the following areas.

First, based on our discussions in Chapter 4, we provided an inventory of the time-related sources attitude change. Our empirical findings further supported the hypothesis that the decision makers' perceptions of IS success change over time. However, because of small sample size, we had to combine both non-adopter firms and those in the process of adoption in one group. A fruitful direction for future exploration is finding out *how* human information processing biases affect decision maker's evaluation of information systems. Multi-group studies employing firms that are at various stages of the adoption process, and focusing on various types of change (alpha, beta, gamma) should help highlight the sources of attitude changes. Another research avenue is to conduct field experiments in order to identify the major biases that lead to temporal instability. These research directions will ultimately allow us to gain a better understanding of how cognitive biases affect the evaluation process. This will in turn lead to the solidification of an articulated theory of IS adoption and assessment process.

Second, we relied on cross-sectional data of firms at different stage of adoption of a particular information technology (EDI). In order to gain a better appreciation of the *process* of IS success assessment, we call for related longitudinal studies that focus on the development and implementation process of different types of information systems.

Third, the structural model of IS success developed in this study provided evidence in support of the hierarchical nature of this construct. What is still not clearly known is the inter-relationship among factors comprising the model of IS success. Additional empirical investigation is required to determine the degree of importance of these factors in influencing the success of information systems. Simultaneous use of alternative measures of IS success will potentially help unravel some of the intricacies associated with the measurement of IS success.

Finally, based on our discussion in Chapter 7 regarding the moderating effect of contextual variables on the IS assessment process, we believe that further research in this area is needed. A more holistic approach to the evaluation of IS success, accounting not only for temporal context and type of system, but also for contextual factors, such as involvement in IS development, appears to be a fertile terrain.

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APPENDICES

Appendix 1 - BASIC Program - Rankings Algorithm

```
1000 REM This program calculates the rankings of all items,
1010 REM rankings of the 3 different versions,
1020 REM and rankings of the adopters and non-adopters
1030 DIM B(25,5),D(25),K(25),A(25,5),D1(25),K1(25),D2(25),K2(25),D3(25),K3(25)
1040 DIM P1(25),E1(25),P2(25),E2(25)
1050 REM K() = Order Total
1060 REM D() = Totals All
1070 REM K1() = Order Version 1
1080 REM D() = Totals Version 1
1090 REM K2() = Order Version 2
1100 REM D2() = Totals Version 2
1110 REM K3() = Order Version 3
1120 REM D3() = Totals Version 3
1130 REM P1() = Order Non-adopters
1140 REM E1() = Totals Non-adopters
1150 REM P2() = Order Adopters
1160 REM E2() = Totals Adopters
1170 OPEN "o", #2 , "output"
1180 OPEN "r",1,"c:\foxbase\quest.txt", 153
1190 FIELD 1, 153 AS X$
1200 INPUT "NUMBER OF CASES? ", NN
1210 INPUT "EDI or INTERNAL?  ", Q$
1220 IF Q$="EDI" THEN QQ=122 ELSE IF Q$="INTERNAL" THEN QQ=132 ELSE 1210
1230 IF Q$="EDI" THEN INPUT "CUTOFF POINT? ",EE
1240 FOR K= 1 TO NN: REM n subjects
1250 GET 1,K
1260 PRINT K
1270 KK=VAL(MID$(X$,73,1)):REM Version
1280 ED=VAL(MID$(X$,11,1)):REM Stage of adoption
1290 IF ED>=1 AND ED <=EE THEN PP1=PP1+1: REM non-adopters
1300 IF ED>EE THEN PP2=PP2+1:REM adopters
1310 IF KK=1 THEN VK1=VK1+1 ELSE IF KK=2 THEN VK2=VK2+1
1320 IF KK=3 THEN VK3=VK3+1: REM decide on the version
1330 FOR I= 1 TO 5: C(I)=VAL (MID$(X$,QQ+I*2,2)):NEXT I: REM extract the values
1340 IF KK= 3 THEN GOSUB 2350
1350 IF KK= 2 THEN GOSUB 2400
1360 FOR I= 1 TO 5
1370 IF C(I) =99 THEN 1420: REM skip if missing value
1380 FOR J= 1 TO 25
1390 IF C(I) <> J THEN 1410
1400 B(J,I) =25-I:J=25: REM assign 24-20 to top 5, 0 to all others
1410 NEXT J
1420 NEXT I
1430 FOR I= 1 TO 5
1440 FOR J= 1 TO 25
1450 D(J) = D(J)+B(J,I): REM accumulate total for all items
1460 IF KK=1 THEN D1(J) = D1(J)+B(J,I): REM total for version 1
1470 IF KK=2 THEN D2(J) = D2(J)+B(J,I): REM total for version 2
1480 IF KK=3 THEN D3(J) = D3(J)+B(J,I): REM total for version 3
```

```
1490 IF ED>=1 AND ED <=EE THEN E1(J)=E1(J)+B(J,I): REM non-adopters
1500 IF ED>EE THEN E2(J)=E2(J) + B(J,I): REM total for Adopters
1510 NEXT J:NEXT I
1520 FOR J= 1 TO 25
1530 FOR I= 1 TO 5
1540 IF B(J,I)<>0 THEN A(J,I)=A(J,I)+1:AA=AA+1: REM total freq. For all items
1550 IF B(J,I)<>0 AND KK=1 THEN A1=A1+1:REM total freq. for items, version 1
1560 IF B(J,I)<>0 AND KK=2 THEN A2=A2+1:REM total freq. for items, version 2
1570 IF B(J,I)<>0 AND KK=3 THEN A3=A3+1:REM total freq. for items, version 3
1580 IF B(J,I)<>0 AND ED>=1 AND ED <=EE THEN A4=A4+1:REM freq. non-adopters
1590 IF B(J,I)<>0 AND ED>EE THEN A5=A5+1:REM freq. adopters
1600 B(J,I)=0: REM set all to 0
1610 NEXT I
1620 NEXT J
1630 NEXT K
1640 AA=22*AA:A1=22*A1:A2=22*A2:A3=22*A3:A4=22*A4:A5=22*A5:REM find numerators
1650 WRITE #2, Q$, "Rankings of all variables"
1660 FOR J= 1 TO 25:FOR I= 1 TO 5:WRITE #2, A(J,I):NEXT I: NEXT J: WRITE #2,AA
1670 REM keep track of order of items
1680 FOR I=1 TO 25 :K(I)=I:K1(I)=I:K2(I)=I:K3(I)=I:P1(I)=I:P2(I)=I: NEXT I
1690 WRITE #2, Q$, "Rankings Totals, Unsorted"
1700 FOR I=1 TO 25
1710 WRITE #2, K(I),D(I), INT(10000*D(I)/AA)/100
1720 NEXT
1730 WRITE #2, Q$, "Rankings Version 1, Unsorted.  N=",VK1
1740 FOR I=1 TO 25
1750 WRITE #2, K1(I),D1(I),INT(10000*D1(I)/A1)/100
1760 NEXT
1770 WRITE #2, Q$, "Rankings Version 2, Unsorted.  N=",VK2
1780 FOR I=1 TO 25
1790 WRITE #2, K2(I),D2(I),INT(10000*D2(I)/A2)/100
1800 NEXT
1810 WRITE #2, Q$, "Rankings Version 3, Unsorted.  N=",VK3
1820 FOR I=1 TO 25
1830 WRITE #2, K3(I),D3(I),INT(10000*D3(I)/A3)/100
1840 NEXT
1850 IF Q$="INTERNAL" THEN 1940
1860 WRITE #2, Q$, "Rankings Non-adopters, Unsorted.  N=",PP1
1870 FOR I=1 TO 25
1880 WRITE #2, P1(I),E1(I),INT(10000*E1(I)/A4)/100
1890 NEXT
1900 WRITE #2, Q$, "Rankings Adopters, Unsorted.  N=",PP2
1910 FOR I=1 TO 25
1920 WRITE #2, P2(I),E2(I),INT(10000*E2(I)/A5)/100
1930 NEXT
1940 C= 1:REM sort
1950 WHILE C<= 24
1960  J=C+1
1970  WHILE  J<= 25
```

```
1980    IF D(C) > D(J) THEN SWAP D(C),D(J):SWAP K(C),K(J)
1990    IF D1(C) > D1(J) THEN SWAP D1(C),D1(J):SWAP K1(C),K1(J)
2000    IF D2(C) > D2(J) THEN SWAP D2(C),D2(J):SWAP K2(C),K2(J)
2010    IF D3(C) > D3(J) THEN SWAP D3(C),D3(J):SWAP K3(C),K3(J)
2020    IF E1(C) > E1(J) THEN SWAP E1(C),E1(J):SWAP P1(C),P1(J)
2030    IF E2(C) > E2(J) THEN SWAP E2(C),E2(J):SWAP P2(C),P2(J)
2040    J= J+1
2050  WEND
2060  C=C+1
2070 WEND
2080 WRITE #2, Q$, "Rankings Totals, Sorted"
2090 FOR I=1 TO 25
2100 WRITE #2, K(I),D(I),INT(10000*D(I)/AA)/100
2110 NEXT
2120 WRITE #2, Q$, "Rankings Version 1, Sorted.  N=",VK1
2130 FOR I=1 TO 25
2140 WRITE #2, K1(I),D1(I),INT(10000*D1(I)/A1)/100
2150 NEXT
2160 WRITE #2, Q$, "Rankings Version 2, Sorted.  N=",VK2
2170 FOR I=1 TO 25
2180 WRITE #2, K2(I),D2(I),INT(10000*D2(I)/A2)/100
2190 NEXT
2200 WRITE #2, Q$, "Rankings Version 3, Sorted.  N=",VK3
2210 FOR I=1 TO 25
2220 WRITE #2, K3(I),D3(I),INT(10000*D3(I)/A3)/100
2230 NEXT
2240 IF Q$="INTERNAL" THEN 2330
2250 WRITE #2, Q$, "Rankings Non-adopters, Sorted.  N=",PP1
2260 FOR I=1 TO 25
2270 WRITE #2, P1(I),E1(I),INT(10000*E1(I)/A4)/100
2280 NEXT
2290 WRITE #2, Q$, "Rankings Adopters, Sorted.  N=",PP2
2300 FOR I=1 TO 25
2310 WRITE #2, P2(I),E2(I),INT(10000*E2(I)/A5)/100
2320 NEXT
2330 CLOSE #1, #2
2340 END
2350 REM conversion for version 3
2360  FOR I=1 TO 5
2370 IF C(I) >=1 AND C(I) <=6 THEN C(I) =C(I)+6: GOTO 2390
2380 IF C(I) >=7 AND C(I) <=12 THEN C(I) =C(I)-6:
2390 NEXT I:RETURN
2400 REM conversion for version 2
2410  FOR I=1 TO 5
2420 IF C(I) <=8 AND C(I) >0 THEN C(I) =C(I)+12:GOTO 2450
2430 IF C(I) <=14 AND C(I) >8 THEN C(I) =C(I)-2:GOTO 2450
2440 IF C(I) <=20 AND C(I) >14 THEN C(I) =C(I)-14
2450 NEXT I:RETURN
```

Appendix 2 - Questionnaire's Cover Letters

McGill

Faculty of Management
Samuel Bronfman Building
McGill University

Postal address:
1001 Sherbrooke Street West
Montreal, PQ, Canada H3A 1G5

Tel.: (514) 398-4000
Fax: (514) 398-3876
Telex: 0524111

November 23, 1990

Dear Colleague:

In cooperation with the EDI Council of Canada, we are conducting a survey of companies that are in the process of planning or implementing electronic data interchange (EDI) systems. The survey will be mailed out in January 1991. In the meantime, we are conducting this preliminary, pre-survey study.

Kindly indicate your willingness to participate in this project by answering the question below and returning this letter in the enclosed self-addressed stamped envelope. Also, please make the necessary changes if any part of the above address label is incorrect.

Since we are interested only in aggregate data, the survey will not request any information regarding the identity of participants.

We shall be pleased to send interested participants a summary of the survey results upon completion.

Thank you very much for your cooperation.

Sincerely,

Ali F. Farhoomand

At what stage of implementation of EDI is your company?

[] Feasibility study
[] Technical specifications
[] Legal and auditing requirements
[] Pilot program
[] Full implementation

[] Currently no EDI program under way

McGill

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Fax: (514) 398-3876
Telex: 0524111

le 23 novembre, 1991

Cher(chère) collègue,

Nous éffectuons un sondage en collaboration avec "Electronic Data Interchange Council of Canada" et CIPS afin d'obtenir une image précise de la situation actuelle de l'utilisation de l'échange éleétronique de données (EED). Le sondage sera posté en janvier 1991. Entretemps, nous éffectuons le present sondage préliminaire.

S'il vous plairait de prendre part à cette enquête, veuillez répondre à la question ci-dessous en cochant la case appropriée. Une enveloppe timbrée pour la reponse est incluse. De plus, nous vous prions de faire les changements necessaires si l'adresse ou le nom indiqués ci-dessus sont incorrects.

Puisque nous nous intéressons uniquement aux données collectives, il n'est pas nécéssaire d'indiquer l'identité des participants dans le sondage à venir.

Il nous fera plaisir d'envoyer un resumé de l'enquête lorsque celle-ci sera completée, aux participants qui le desirent.

Nous vous remercions de votre collaboration dans cette enquête.

Sincèrement,

Ali F. Farhoomand

Quel est l'état actuel de vos activités en EED?

[] Étude de faisabilite
[] Spécifications téchniques
[] Verification et étude légale
[] Projets pilotes
[] Implantation en cours
[] Implantation complètée

[] Aucun projet de l'EED en cours

McGill

Faculty of Management
Samuel Bronfman Building
McGill University

Postal address:
1001 Sherbrooke Street West
Montreal PQ, Canada H3A 1G5

Tel.: (514) 398-4000
Fax: (514) 398-3876
Telex: 0524111

February 6, 1991

Dear Colleague:

We are in the process of conducting a survey related to various issues surrounding the successful implementation of *Electronic Data Interchange (EDI)*. This survey, which is a part of a doctoral dissertation, is being conducted in cooperation with the *EDI Council of Canada* and the *Canadian Information Processing Society*.

We would like to request for your cooperation in filling out a questionnaire that will be sent out shortly. We would be pleased to send a summary of the survey results to the participants.

If you *do not* want to participate in this study, please so indicate by returning this letter in the enclosed self-addressed stamped envelope. If you intend to take part in the study, please discard this letter. We will be contacting you shortly.

Thank you very much for your cooperation.

Sincerely

Ali F. Farhoomand

[] No, I do not wish to participate

McGill

Faculty of Management
Samuel Bronfman Building
McGill University

Postal address:
1001 Sherbrooke Street West
Montreal, PQ, Canada H3A 1G5

Tel. (514) 398-4000
Fax (514) 398-3876
Telex 0524111

Feb. 25, 1991

Dear Colleague:

Thank you very much for agreeing to participate in the **Electronic Data Interchange (EDI) Survey**. This survey, which is a part of a doctoral dissertation, is being conducted in cooperation with the *EDI Council of Canada* and the *Canadian Information Processing Society.* The objective of the project is to gain some insight into the factors influencing the successful implementation of EDI and other types of computer-based information systems.

The enclosed questionnaire will take only a few minutes of your time. We would greatly appreciate it if you would complete the questionnaire and return it in the enclosed self-addressed stamped envelope by March 20, 1991. Since we are interested only in aggregate data, we will keep all information obtained from individual participants in complete confidence.

We would be pleased to send you a summary of the survey results, if you so indicate on the form in the back of the questionnaire.

Thank you very much for your cooperation.

Sincerely

Ali F. Farhoomand

Encl.

McGill

Faculty of Management
Samuel Bronfman Building
McGill University

Postal address:
1001 Sherbrooke Street West
Montreal, PQ, Canada H3A 1G5

Tel.: (514) 398-4000
Fax: (514) 398-3876
Telex: 0524111

Le 25 février 1991

Cher(chère) collègue,

Nous vous remercions de prendre part au sondage de **"Electronic Data Interchange" (EDI).** Ce sondage qui fait partie d'une dissertation doctorale est effectué en collaboration avec *EDI Council of Canada* ainsi qu'avec *l'Association Canadienne d'Informatique*. Le but de cette recherche vise à obtenir une image précise des facteurs qui influencent l'implantation réussie de l'EDI et d'autres types de systèmes informatiques.

Le questionnaire ci-joint prend peu de temps à répondre. Nous apprécierions grandement si vous pouviez compléter ce questionnaire et nous le retourner d'ici le 20 mars 1991. Une enveloppe timbrée et adressée à l'envoyeur est incluse à cet égard. Puisque nous nous intéressons uniquement aux données collectives, tous renseignements fournis par les participants seront considérés confidentiels.

Il nous fera un plaisir d'envoyer un résumé de l'enquête, à la condition d'indiquer votre intérêt sur le formulaire annexé à la fin du questionnaire.

Nous vous remercions de votre collaboration dans cette enquête.

Sincèrement,

Ali F. Farhoomand

p.j.

McGill

Faculty of Management
Samuel Bronfman Building
McGill University

Postal address:
1001 Sherbrooke Street West
Montreal, PQ, Canada H3A 1G5

Tel.: (514) 398-4000
Fax: (514) 398-3876
Telex: 0524111

May 3, 1991

Dear Colleague:

We are enclosing a second copy of the questionnaire which we sent to you last month. The purpose of this survey is to gain some insight into various issues related to the implementation of Electronic Data Interchange (EDI) and other types of computer-based information systems. We are interested in responses from companies that have or have not adopted EDI. Your response will be used in the empirical part of a doctoral dissertation.

The enclosed questionnaire will take only five minutes of your time. If you have not already filled out the questionnaire, we would greatly appreciate it if you would do so and return it in the enclosed self-addressed stamped envelope by May 17, 1991. Since we are interested only in aggregate data, we will keep all information obtained from individual participants in complete confidence.

We would be pleased to send you a summary of the survey results, if you so indicate on the form in the back of the questionnaire.

Thank you very much for your cooperation.

Sincerely

Ali F. Farhoomand

Encl.

Appendix 3 - Three Versions of the Questionnaire

Version 1

McGill University

Electronic Data Interchange Survey

In cooperation with

EDI Council of Canada
and
Canadian Information Processing Society

This questionnaire elicits information related to various types of computer-based information systems, particularly Electronic Data Interchange (EDI).

EDI is defined as the corporate-to-corporate exchange of business documents in a *structured* format. EDI *is not* electronic transmission of data in a free form. Therefore, it excludes facsimile (fax) transmission, which requires rekeying of data by the receiving party, and electronic mail (e-mail), which requires rekeying or editing of data. However, it includes tape exchange of business documents in an EDI related format.

Section I. General Questions

1. What are the annual sales of your company?

- [] Less than \$5 million
- [] \$5 - \$9 million
- [] \$10 - \$24 million
- [] \$25 - \$49 million
- [] \$50 - \$99 million
- [] \$100 - \$249 million
- [] \$250 - \$999 million
- [] \$1 billion or more

2. What line of business is your company in?

- [] Chemicals
- [] Communications
- [] Financial
- [] Food Manufacturing & Tobacco
- [] Government
- [] Insurance
- [] Metals, Machinery & Equipment
- [] Mining, Oil & Gas
- [] Pharmaceutical & Health Services
- [] Printing & Publishing
- [] Pulp & Paper
- [] Retail Stores
- [] Textile & Apparel
- [] Transportation
- [] Utilities
- [] Wholesale Trade
- [] Other ________________

3. How best do you characterize the stage of implementation of the EDI program in your company? *(Choose only one option)*

- [] Currently no EDI program under way

- [] Feasibility study
- [] Technical specifications
- [] Legal and auditing requirements
- [] Pilot program

- [] Currently EDI in operation mode

Section II. Personal Questions

1. In what functional area of business do you work?

- [] Finance
- [] Information Systems
- [] Production/Manufacturing
- [] Purchasing
- [] Sales/Marketing
- [] Transportation/Logistics
- [] Other ______________

2. What is your title?

- [] President/VP
- [] Director/Manager/Coordinator
- [] Other ______________

3. What is your educational background?

- [] Computer Science/MIS
- [] Business Administration
- [] Engineering
- [] Arts/Sciences
- [] Other ______________

4. Do you classify yourself as a *user* of EDI?

[] Yes [] No

5. Overall, how familiar are you with EDI systems?

- [] Highly familiar
- [] Moderately familiar
- [] Somewhat familiar
- [] A little familiar
- [] Not familiar at all

6. How best do you characterize your involvement with the EDI project in your company?

- [] Very involved
- [] Moderately involved
- [] Somewhat involved
- [] Little involved
- [] Not involved at all

PLEASE SKIP THIS PAGE IF THERE IS CURRENTLY NO EDI PROGRAM UNDER WAY IN YOUR COMPANY.

SECTION III. EDI QUESTIONS

1. What was the *main* reason your company decided to use EDI? *(Chose only one)*

[] Request from trading partner(s)
[] Push by industry
[] Response to internal inefficiencies
[] Other ________________

2. What percentage of your inter-corporate documents are currently exchanged via EDI?

[] 0%
[] 1% - 24%
[] 25% - 49%
[] 50% - 74%
[] 75% or more
[] Don't know

3. How many inter-corporate documents per month are exchanged via EDI?

[] Less than 100
[] 100 - 999
[] 1,000 - 4,999
[] 5,000 - 9,999
[] 10,000 - 24,999
[] 25,000 - 99,999
[] 100,000 or more
[] Don't know

4. In the long run, what percentage of inter-corporate documents does your company intend to exchange via EDI?

[] 1% - 24%
[] 25% - 49%
[] 50% - 74%
[] 75% or more
[] Don't know

5. When did your company start to receive or send business documents via EDI?

|____|____|____| *Received* |____|____|____| *Sent*

6. What standard format is being used in your EDI environment?

[] ANSI X.12
[] Proprietary
[] EDIFACT
[] Other ________________

7. Is your EDI system fully integrated with the internal information systems in your company?

[] Yes
[] No
[] Don't know

8. How many full-time people work on the EDI project in your company?

[] None
[] 1-2
[] 3-5
[] 6 or more
[] Don't know

9. What have been the most important barriers to using or increasing the use of EDI with your trading partners? *(Check as many as apply)*

[] System cost
[] Security concerns
[] Lack of standards
[] Lack of training
[] Management attitude
[] Other ________________

Section IV. Satisfaction with Information Systems and Services

This section is designed to measure your personal *feelings* about ALL computer-based information systems used at your firm. Please check each scale in the position that describes your evaluation of the factor being judged. Check only one position on each scale.

Work rapidly; rely on your first impressions. Please do not omit any scale.

1. Relationship with MIS[1] staff: the manner and methods of interaction, conduct and association between the user and the MIS staff.

   harmonious : : : : : : : : dissonant

   good : : : : : : : : bad

2. Processing of requests for changes to existing systems: the manner, method, and required time with which the MIS staff responds to user requests for changes in existing computer-based information systems or services.

   fast : : : : : : : : slow

   timely : : : : : : : : untimely

3. Degree of MIS training provided to users: the amount of specialized instruction and practice that is afforded to the user to increase the user's proficiency in utilizing the available computer capability.

   complete : : : : : : : : incomplete

   high : : : : : : : : low

4. User's understanding of systems: the degree of comprehension that the user possesses about the computer-based information systems or services that are provided.

   sufficient : : : : : : : : insufficient

   complete : : : : : : : : incomplete

5. User's feelings of participation: the degree of involvement and commitment which the user shares with the MIS staff and others toward the functioning of the computer-based information systems and services.

   positive : : : : : : : : negative

   sufficient : : : : : : : : insufficient

6. Attitude of MIS staff: the willingness and commitment of the MIS staff to subjugate external, professional goals in favour of organizationally directed goals and tasks.

   cooperative : : : : : : : : belligerent

   positive : : : : : : : : negative

7. Reliability of output information: the consistency and dependability of the output information.

   high : : : : : : : : low

   superior : : : : : : : : inferior

[1] MIS refers to *Management Information systems*.

SECTION IV. SATISFACTION WITH INFORMATION SYSTEMS AND SERVICES (CONT'D)

8. Relevancy of output information (to intended function): the degree of congruence between what the user wants or requires and what is provided by the information products and services.

useful : : : : : : : : useless

relevant : : : : : : : : irrelevant

9. Accuracy of output information: the correctness of the output information.

accurate : : : : : : : : inaccurate

high : : : : : : : : low

10. Precision of output information: the variability of the output information from that which it purports to measure.

high : : : : : : : : low

definite : : : : : : : : indefinite

11. Communication with the MIS staff: the manner and methods of information exchange between the user and the MIS staff.

harmonious : : : : : : : : dissonant

productive : : : : : : : : unproductive

12. Time required for new systems development: the elapsed time between the user's request for new applications and the design, development, and/or implementation of the applications systems by the MIS staff.

reasonable : : : : : : : : unreasonable

acceptable : : : : : : : : unacceptable

13. Completeness of the output information: the comprehensiveness of the output information content.

sufficient : : : : : : : : insufficient

adequate : : : : : : : : inadequate

Summary

14. How satisfied are you with your involvement and participation in the operation and ongoing development of information systems?

satisfied : : : : : : : : dissatisfied

15. How satisfied are you with the support and services of the MIS department?

satisfied : : : : : : : : dissatisfied

16. How satisfied are you with the information product itself?

satisfied : : : : : : : : dissatisfied

17. In summary, how satisfied are you with the *entire* information systems environment?

satisfied : : : : : : : : dissatisfied

Section V. Success Factors

<u>Please answer all the questions on this page regardless of whether or not there is an EDI system in your company.</u>

Consider the following aspects of an information system. Using the scale below, indicate the extent to which each aspect influences the SUCCESS of the system.

Not Applicable	*No Extent At All*	*Little Extent*	*Some Extent*	*Great Extent*	*Full Extent*
0	*1*	*2*	*3*	*4*	*5*

The first column of numbers relates to your evaluation of EDI systems, while the second column of numbers relates to your evaluation of INTERNAL information systems such as payroll and accounts payable.

<u>Quality of output</u>			E D I						INTERNAL			
1. Accuracy of output information	0	1	2	3	4	5	0	1	2	3	4	5
2. Relevance of report contents to intended function	0	1	2	3	4	5	0	1	2	3	4	5
3. Completeness of output information	0	1	2	3	4	5	0	1	2	3	4	5
4. Precision of output information	0	1	2	3	4	5	0	1	2	3	4	5
5. Reliability of output information	0	1	2	3	4	5	0	1	2	3	4	5
6. Timeliness of report delivery to users	0	1	2	3	4	5	0	1	2	3	4	5

<u>System's Characteristics</u>												
7. Overall cost-effectiveness of the system	0	1	2	3	4	5	0	1	2	3	4	5
8. Reliability of the system	0	1	2	3	4	5	0	1	2	3	4	5
9. Ease of use of the system	0	1	2	3	4	5	0	1	2	3	4	5
10. Adequacy of system's storage capacity	0	1	2	3	4	5	0	1	2	3	4	5
11. Adequacy of system's processing speed	0	1	2	3	4	5	0	1	2	3	4	5
12. Accessibility of the system	0	1	2	3	4	5	0	1	2	3	4	5

<u>System's Outcomes</u>												
13. Improvement of your company's image in industry	0	1	2	3	4	5	0	1	2	3	4	5
14. Improvement in customer services	0	1	2	3	4	5	0	1	2	3	4	5
15. Increase in inter-corporate transactions	0	1	2	3	4	5	0	1	2	3	4	5
16. Enhancement of inter-corporate coordinative efforts	0	1	2	3	4	5	0	1	2	3	4	5
17. Increase in sales	0	1	2	3	4	5	0	1	2	3	4	5
18. Decrease in inventory, personnel, or transaction costs	0	1	2	3	4	5	0	1	2	3	4	5
19. Reduction in paper work	0	1	2	3	4	5	0	1	2	3	4	5
20. Improvement in capturing and controlling of data	0	1	2	3	4	5	0	1	2	3	4	5

<u>Aspects Related to Users, MIS staff, and Top Management</u>												
21. Overall support provided to users by MIS staff	0	1	2	3	4	5	0	1	2	3	4	5
22. Users' understanding of the system	0	1	2	3	4	5	0	1	2	3	4	5
23. Users' participation in the development and implementation	0	1	2	3	4	5	0	1	2	3	4	5
24. Training provided to users	0	1	2	3	4	5	0	1	2	3	4	5
25. Top management involvement in defining MIS policies	0	1	2	3	4	5	0	1	2	3	4	5

Section VI. Rankings

Using the items on the opposite page, please RANK the top five most important aspects that you feel influence the success of EDI and INTERNAL systems, 1 being the most important, 5 being the fifth most important aspect. In the space provided, write the numbers (1-25) of the most important aspect, second most important aspect, etc., for each type of system.

___ ___ ___ ___ ___
1 2 3 4 5
E D I

___ ___ ___ ___ ___
1 2 3 4 5
INTERNAL

Section VII. Overall Evaluation of Internal and EDI Systems

1. How do you rate the overall degree of success of internal systems such as payroll and accounts payable in your company?

Don't Know	*Extremely Unsuccessful*	*Unsuccessful*	*Neutral*	*Successful*	*Extremely Successful*
0	1	2	3	4	5

2. How do you rate the extent to which internal systems such as payroll and accounts payable in your company have achieved their objectives?

Don't Know	*No Extent At All*	*Little Extent*	*Some Extent*	*Great Extent*	*Full Extent*
0	1	2	3	4	5

3. How satisfied are you with internal systems such as payroll and accounts payable in your company?

Don't Know	*Extremely Dissatisfied*	*Dissatisfied*	*Neutral*	*Satisfied*	*Extremely Satisfied*
0	1	2	3	4	5

Please skip Questions 4-6 if there is currently no EDI program under way in your company.

4. So far, how do you rate the overall degree of success of the edi program in your company?

Don't Know	*Extremely Unsuccessful*	*Unsuccessful*	*Neutral*	*Successful*	*Extremely Successful*
0	1	2	3	4	5

5. So far, how do you rate the extent to which the edi program in your company has achieved its objectives?

Don't Know	*No Extent At All*	*Little Extent*	*Some Extent*	*Great Extent*	*Full Extent*
0	1	2	3	4	5

6. So far, how satisfied are you with the edi program in your company?

Don't Know	*Extremely Dissatisfied*	*Dissatisfied*	*Neutral*	*Satisfied*	*Extremely Satisfied*
0	1	2	3	4	5

THANK YOU VERY MUCH FOR YOUR TIME.

IF YOU WOULD LIKE TO RECEIVE A SUMMARY OF THE RESULTS OF THIS SURVEY, PLEASE FILL OUT THE FORM BELOW. OR IF YOU PREFER, INSERT YOUR BUSINESS CARD IN THE ENCLOSED POST-PAID ENVELOPE.

Name: ______________________________

Title: ______________________________

Company: ___________________________

Address: ____________________________

____

____

Version 2

McGill University

Electronic Data Interchange Survey

In cooperation with

EDI Council of Canada
and
Canadian Information Processing Society

THIS QUESTIONNAIRE ELICITS INFORMATION RELATED TO VARIOUS TYPES OF COMPUTER-BASED INFORMATION SYSTEMS, PARTICULARLY ELECTRONIC DATA INTERCHANGE (EDI).

EDI IS DEFINED AS THE CORPORATE-TO-CORPORATE EXCHANGE OF BUSINESS DOCUMENTS IN A *STRUCTURED* FORMAT. EDI *IS NOT* ELECTRONIC TRANSMISSION OF DATA IN A FREE FORM. THEREFORE, IT EXCLUDES FACSIMILE (FAX) TRANSMISSION, WHICH REQUIRES REKEYING OF DATA BY THE RECEIVING PARTY, AND ELECTRONIC MAIL (E-MAIL), WHICH REQUIRES REKEYING OR EDITING OF DATA. HOWEVER, IT INCLUDES TAPE EXCHANGE OF BUSINESS DOCUMENTS IN AN EDI RELATED FORMAT.

Section I. General Questions

1. What are the annual sales of your company?

- [] Less than $5 million
- [] $5 - $9 million
- [] $10 - $24 million
- [] $25 - $49 million
- [] $50 - $99 million
- [] $100 - $249 million
- [] $250 - $999 million
- [] $1 billion or more

2. What line of business is your company in?

- [] Chemicals
- [] Communications
- [] Financial
- [] Food Manufacturing & Tobacco
- [] Government
- [] Insurance
- [] Metals, Machinery & Equipment
- [] Mining, Oil & Gas
- [] Pharmaceutical & Health Services
- [] Printing & Publishing
- [] Pulp & Paper
- [] Retail Stores
- [] Textile & Apparel
- [] Transportation
- [] Utilities
- [] Wholesale Trade
- [] Other ______________

3. How best do you characterize the stage of implementation of the EDI program in your company? *(Choose only one option)*

- [] Currently no EDI program under way

- [] Feasibility study
- [] Technical specifications
- [] Legal and auditing requirements
- [] Pilot program

- [] Currently EDI in operation mode

Section II. Personal Questions

1. In what functional area of business do you work?

- [] Finance
- [] Information Systems
- [] Production/Manufacturing
- [] Purchasing
- [] Sales/Marketing
- [] Transportation/Logistics
- [] Other ______________

2. What is your title?

- [] President/VP
- [] Director/Manager/Coordinator
- [] Other ______________

3. What is your educational background?

- [] Computer Science/MIS
- [] Business Administration
- [] Engineering
- [] Arts/Sciences
- [] Other ______________

4. Do you classify yourself as a *user* of EDI?

[] Yes   [] No

5. Overall, how familiar are you with EDI systems?

- [] Highly familiar
- [] Moderately familiar
- [] Somewhat familiar
- [] A little familiar
- [] Not familiar at all

6. How best do you characterize your involvement with the EDI project in your company?

- [] Very involved
- [] Moderately involved
- [] Somewhat involved
- [] Little involved
- [] Not involved at all

PLEASE SKIP THIS PAGE IF THERE IS CURRENTLY NO EDI PROGRAM UNDER WAY IN YOUR COMPANY.

SECTION III. EDI QUESTIONS

1. What was the *main* reason your company decided to use EDI? *(Chose only one)*

   [] Request from trading partner(s)
   [] Push by industry
   [] Response to internal inefficiencies
   [] Other ___________________

2. What percentage of your inter-corporate documents are currently exchanged via EDI?

   [] 0%
   [] 1% - 24%
   [] 25% - 49%
   [] 50% - 74%
   [] 75% or more
   [] Don't know

3. How many inter-corporate documents per month are exchanged via EDI?

   [] Less than 100
   [] 100 - 999
   [] 1,000 - 4,999
   [] 5,000 - 9,999
   [] 10,000 - 24,999
   [] 25,000 - 99,999
   [] 100,000 or more
   [] Don't know

4. In the long run, what percentage of inter-corporate documents does your company intend to exchange via EDI?

   [] 1% - 24%
   [] 25% - 49%
   [] 50% - 74%
   [] 75% or more
   [] Don't know

5. When did your company start to receive or send business documents via EDI?

   |____|____|____| *Received* |____|____|____| *Sent*

6. What standard format is being used in your EDI environment?

   [] ANSI X.12
   [] Proprietary
   [] EDIFACT
   [] Other ___________________

7. Is your EDI system fully integrated with the internal information systems in your company?

   [] Yes
   [] No
   [] Don't know

8. How many full-time people work on the EDI project in your company?

   [] None
   [] 1-2
   [] 3-5
   [] 6 or more
   [] Don't know

9. What have been the most important barriers to using or increasing the use of EDI with your trading partners? *(Check as many as apply)*

   [] System cost
   [] Security concerns
   [] Lack of standards
   [] Lack of training
   [] Management attitude
   [] Other ___________________

Section IV. Satisfaction with Information Systems and Services

This section is designed to measure your personal feelings about ALL computer-based information systems used at your firm. Please check each scale in the position that describes your evaluation of the factor being judged. Check only one position on each scale.

Work rapidly; rely on your first impressions. Please do not omit any scale.

1. Relationship with MIS[1] staff: the manner and methods of interaction, conduct and association between the user and the MIS staff.

   harmonious _:_:_:_:_:_:_:_: dissonant

   good _:_:_:_:_:_:_:_: bad

2. Processing of requests for changes to existing systems: the manner, method, and required time with which the MIS staff responds to user requests for changes in existing computer-based information systems or services.

   fast _:_:_:_:_:_:_:_: slow

   timely _:_:_:_:_:_:_:_: untimely

3. Degree of MIS training provided to users: the amount of specialized instruction and practice that is afforded to the user to increase the user's proficiency in utilizing the available computer capability.

   complete _:_:_:_:_:_:_:_: incomplete

   high _:_:_:_:_:_:_:_: low

4. User's understanding of systems: the degree of comprehension that the user possesses about the computer-based information systems or services that are provided.

   sufficient _:_:_:_:_:_:_:_: insufficient

   complete _:_:_:_:_:_:_:_: incomplete

5. User's feelings of participation: the degree of involvement and commitment which the user shares with the MIS staff and others toward the functioning of the computer-based information systems and services.

   positive _:_:_:_:_:_:_:_: negative

   sufficient _:_:_:_:_:_:_:_: insufficient

6. Attitude of MIS staff: the willingness and commitment of the MIS staff to subjugate external, professional goals in favour of organizationally directed goals and tasks.

   cooperative _:_:_:_:_:_:_:_: belligerent

   positive _:_:_:_:_:_:_:_: negative

7. Reliability of output information: the consistency and dependability of the output information.

   high _:_:_:_:_:_:_:_: low

   superior _:_:_:_:_:_:_:_: inferior

---

[1] MIS refers to *Management Information systems.*

Section IV. Satisfaction with Information Systems and Services (Cont'd)

8. Relevancy of output information (to intended function): the degree of congruence between what the user wants or requires and what is provided by the information products and services.

useful : : : : : : : : useless

relevant : : : : : : : : irrelevant

9. Accuracy of output information: the correctness of the output information.

accurate : : : : : : : : inaccurate

high : : : : : : : : low

10. Precision of output information: the variability of the output information from that which it purports to measure.

high : : : : : : : : low

definite : : : : : : : : indefinite

11. Communication with the MIS staff: the manner and methods of information exchange between the user and the MIS staff.

harmonious : : : : : : : : dissonant

productive : : : : : : : : unproductive

12. Time required for new systems development: the elapsed time between the user's request for new applications and the design, development, and/or implementation of the applications systems by the MIS staff.

reasonable : : : : : : : : unreasonable

acceptable : : : : : : : : unacceptable

13. Completeness of the output information: the comprehensiveness of the output information content.

sufficient : : : : : : : : insufficient

adequate : : : : : : : : inadequate

Summary

14. How satisfied are you with your involvement and participation in the operation and ongoing development of information systems?

satisfied : : : : : : : : dissatisfied

15. How satisfied are you with the support and services of the MIS department?

satisfied : : : : : : : : dissatisfied

16. How satisfied are you with the information product itself?

satisfied : : : : : : : : dissatisfied

17. In summary, how satisfied are you with the *entire* information systems environment?

satisfied : : : : : : : : dissatisfied

Section V. Success Factors

Please answer all the questions on this page regardless of whether or not there is an EDI system in your company.

Consider the following aspects of an information system. Using the scale below, indicate the extent to which each aspect influences the SUCCESS of the system.

Not Applicable	No Extent At All	Little Extent	Some Extent	Great Extent	Full Extent
0	1	2	3	4	5

The first column of numbers relates to your evaluation of EDI systems, while the second column of numbers relates to your evaluation of INTERNAL information systems such as payroll and accounts payable.

	EDI						INTERNAL					
System's Characteristics												
1. Overall cost-effectiveness of the system	0	1	2	3	4	5	0	1	2	3	4	5
2. Reliability of the system	0	1	2	3	4	5	0	1	2	3	4	5
3. Ease of use of the system	0	1	2	3	4	5	0	1	2	3	4	5
4. Adequacy of system's storage capacity	0	1	2	3	4	5	0	1	2	3	4	5
5. Adequacy of system's processing speed	0	1	2	3	4	5	0	1	2	3	4	5
6. Accessibility of the system	0	1	2	3	4	5	0	1	2	3	4	5
Quality of output												
7. Accuracy of output information	0	1	2	3	4	5	0	1	2	3	4	5
8. Relevance of report contents to intended function	0	1	2	3	4	5	0	1	2	3	4	5
9. Completeness of output information	0	1	2	3	4	5	0	1	2	3	4	5
10. Precision of output information	0	1	2	3	4	5	0	1	2	3	4	5
11. Reliability of output information	0	1	2	3	4	5	0	1	2	3	4	5
12. Timeliness of report delivery to users	0	1	2	3	4	5	0	1	2	3	4	5
System's Outcomes												
13. Improvement of your company's image in industry	0	1	2	3	4	5	0	1	2	3	4	5
14. Improvement in customer services	0	1	2	3	4	5	0	1	2	3	4	5
15. Increase in inter-corporate transactions	0	1	2	3	4	5	0	1	2	3	4	5
16. Enhancement of inter-corporate coordinative efforts	0	1	2	3	4	5	0	1	2	3	4	5
17. Increase in sales	0	1	2	3	4	5	0	1	2	3	4	5
18. Decrease in inventory, personnel, or transaction costs	0	1	2	3	4	5	0	1	2	3	4	5
19. Reduction in paper work	0	1	2	3	4	5	0	1	2	3	4	5
20. Improvement in capturing and controlling of data	0	1	2	3	4	5	0	1	2	3	4	5
Aspects Related to Users, MIS staff, and Top Management												
21. Overall support provided to users by MIS staff	0	1	2	3	4	5	0	1	2	3	4	5
22. Users' understanding of the system	0	1	2	3	4	5	0	1	2	3	4	5
23. Users' participation in the development and implementation	0	1	2	3	4	5	0	1	2	3	4	5
24. Training provided to users	0	1	2	3	4	5	0	1	2	3	4	5
25. Top management involvement in defining MIS policies	0	1	2	3	4	5	0	1	2	3	4	5

Section VI. Rankings

Using the items on the opposite page, please RANK the top five most important aspects that you feel influence the success of EDI and INTERNAL systems, 1 being the most important, 5 being the fifth most important aspect. In the space provided, write the numbers (1-25) of the most important aspect, second most important aspect, etc., for each type of system.

___	___	___	___	___		___	___	___	___	___
1	*2*	*3*	*4*	*5*		*1*	*2*	*3*	*4*	*5*
		EDI						*INTERNAL*		

Section VII. Overall Evaluation of Internal and EDI Systems

1. How do you rate the overall degree of success of internal systems such as payroll and accounts payable in your company?

Don't Know	Extremely Unsuccessful	Unsuccessful	Neutral	Successful	Extremely Successful
0	1	2	3	4	5

2. How do you rate the extent to which internal systems such as payroll and accounts payable in your company have achieved their objectives?

Don't Know	No Extent At All	Little Extent	Some Extent	Great Extent	Full Extent
0	1	2	3	4	5

3. How satisfied are you with internal systems such as payroll and accounts payable in your company?

Don't Know	Extremely Dissatisfied	Dissatisfied	Neutral	Satisfied	Extremely Satisfied
0	1	2	3	4	5

<u>Please skip Questions 4-6 if there is currently no EDI program under way in your company.</u>

4. So far, how do you rate the overall degree of success of the EDI program in your company?

Don't Know	Extremely Unsuccessful	Unsuccessful	Neutral	Successful	Extremely Successful
0	1	2	3	4	5

5. So far, how do you rate the extent to which the EDI program in your company has achieved its objectives?

Don't Know	No Extent At All	Little Extent	Some Extent	Great Extent	Full Extent
0	1	2	3	4	5

6. So far, how satisfied are you with the EDI program in your company?

Don't Know	Extremely Dissatisfied	Dissatisfied	Neutral	Satisfied	Extremely Satisfied
0	1	2	3	4	5

THANK YOU VERY MUCH FOR YOUR TIME.

IF YOU WOULD LIKE TO RECEIVE A SUMMARY OF THE RESULTS OF THIS SURVEY, PLEASE FILL OUT THE FORM BELOW. OR IF YOU PREFER, INSERT YOUR BUSINESS CARD IN THE ENCLOSED POST-PAID ENVELOPE.

Name: ______________________________

Title: ______________________________

Company: ______________________________

Address: ______________________________

____

____

McGill University

Electronic Data Interchange Survey

In cooperation with

EDI Council of Canada
and
Canadian Information Processing Society

This questionnaire elicits information related to various types of computer-based information systems, particularly Electronic Data Interchange (EDI).

EDI is defined as the corporate-to-corporate exchange of business documents in a *structured* format. EDI *is not* electronic transmission of data in a free form. Therefore, it excludes facsimile (fax) transmission, which requires rekeying of data by the receiving party, and electronic mail (e-mail), which requires rekeying or editing of data. However, it includes tape exchange of business documents in an EDI related format.

Section I. General Questions

1. What are the annual sales of your company?

   - [] Less than $5 million
   - [] $5 - $9 million
   - [] $10 - $24 million
   - [] $25 - $49 million
   - [] $50 - $99 million
   - [] $100 - $249 million
   - [] $250 - $999 million
   - [] $1 billion or more

2. What line of business is your company in?

   - [] Chemicals
   - [] Communications
   - [] Financial
   - [] Food Manufacturing & Tobacco
   - [] Government
   - [] Insurance
   - [] Metals, Machinery & Equipment
   - [] Mining, Oil & Gas
   - [] Pharmaceutical & Health Services
   - [] Printing & Publishing
   - [] Pulp & Paper
   - [] Retail Stores
   - [] Textile & Apparel
   - [] Transportation
   - [] Utilities
   - [] Wholesale Trade
   - [] Other ________________

3. How best do you characterize the stage of implementation of the EDI program in your company? *(Choose only one option)*

   - [] Currently no EDI program under way

   - [] Feasibility study
   - [] Technical specifications
   - [] Legal and auditing requirements
   - [] Pilot program

   - [] Currently EDI in operation mode

Section II. Personal Questions

1. In what functional area of business do you work?

   - [] Finance
   - [] Information Systems
   - [] Production/Manufacturing
   - [] Purchasing
   - [] Sales/Marketing
   - [] Transportation/Logistics
   - [] Other ________________

2. What is your title?

   - [] President/VP
   - [] Director/Manager/Coordinator
   - [] Other ________________

3. What is your educational background?

   - [] Computer Science/MIS
   - [] Business Administration
   - [] Engineering
   - [] Arts/Sciences
   - [] Other ________________

4. Do you classify yourself as a *user* of EDI?

   [] Yes [] No

5. Overall, how familiar are you with EDI systems?

   - [] Highly familiar
   - [] Moderately familiar
   - [] Somewhat familiar
   - [] A little familiar
   - [] Not familiar at all

6. How best do you characterize your involvement with the EDI project in your company?

   - [] Very involved
   - [] Moderately involved
   - [] Somewhat involved
   - [] Little involved
   - [] Not involved at all

Please skip this page if there is currently no EDI program under way in your company.

Section III. EDI Questions

1. What was the *main* reason your company decided to use EDI? *(Chose only one)*

   [] Request from trading partner(s)
   [] Push by industry
   [] Response to internal inefficiencies
   [] Other ________________

2. What percentage of your inter-corporate documents are currently exchanged via EDI?

   [] 0%
   [] 1% - 24%
   [] 25% - 49%
   [] 50% - 74%
   [] 75% or more
   [] Don't know

3. How many inter-corporate documents per month are exchanged via EDI?

   [] Less than 100
   [] 100 - 999
   [] 1,000 - 4,999
   [] 5,000 - 9,999
   [] 10,000 - 24,999
   [] 25,000 - 99,999
   [] 100,000 or more
   [] Don't know

4. In the long run, what percentage of inter-corporate documents does your company intend to exchange via EDI?

   [] 1% - 24%
   [] 25% - 49%
   [] 50% - 74%
   [] 75% or more
   [] Don't know

5. When did your company start to receive or send business documents via EDI?

   |___|___|___| *Received* |___|___|___| *Sent*

6. What standard format is being used in your EDI environment?

   [] ANSI X.12
   [] Proprietary
   [] EDIFACT
   [] Other ________________

7. Is your EDI system fully integrated with the internal information systems in your company?

   [] Yes
   [] No
   [] Don't know

8. How many full-time people work on the EDI project in your company?

   [] None
   [] 1-2
   [] 3-5
   [] 6 or more
   [] Don't know

9. What have been the most important barriers to using or increasing the use of EDI with your trading partners? *(Check as many as apply)*

   [] System cost
   [] Security concerns
   [] Lack of standards
   [] Lack of training
   [] Management attitude
   [] Other ________________

Section IV. Satisfaction with Information Systems and Services

This section is designed to measure your personal *feelings* about ALL computer-based information systems used at your firm. Please check each scale in the position that describes your evaluation of the factor being judged. Check only one position on each scale.

Work rapidly; rely on your first impressions. Please do not omit any scale.

1. Relationship with MIS[1] staff: the manner and methods of interaction, conduct and association between the user and the MIS staff.

harmonious : : : : : : : : dissonant

good : : : : : : : : bad

2. Processing of requests for changes to existing systems: the manner, method, and required time with which the MIS staff responds to user requests for changes in existing computer-based information systems or services.

fast : : : : : : : : slow

timely : : : : : : : : untimely

3. Degree of MIS training provided to users: the amount of specialized instruction and practice that is afforded to the user to increase the user's proficiency in utilizing the available computer capability.

complete : : : : : : : : incomplete

high : : : : : : : : low

4. User's understanding of systems: the degree of comprehension that the user possesses about the computer-based information systems or services that are provided.

sufficient : : : : : : : : insufficient

complete : : : : : : : : incomplete

5. User's feelings of participation: the degree of involvement and commitment which the user shares with the MIS staff and others toward the functioning of the computer-based information systems and services.

positive : : : : : : : : negative

sufficient : : : : : : : : insufficient

6. Attitude of MIS staff: the willingness and commitment of the MIS staff to subjugate external, professional goals in favour of organizationally directed goals and tasks.

cooperative : : : : : : : : belligerent

positive : : : : : : : : negative

7. Reliability of output information: the consistency and dependability of the output information.

high : : : : : : : : low

superior : : : : : : : : inferior

[1] MIS refers to *Management Information systems.*

SECTION IV. SATISFACTION WITH INFORMATION SYSTEMS AND SERVICES (CONT'D)

8. Relevancy of output information (to intended function): the degree of congruence between what the user wants or requires and what is provided by the information products and services.

useful : : : : : : : : useless

relevant : : : : : : : : irrelevant

9. Accuracy of output information: the correctness of the output information.

accurate : : : : : : : : inaccurate

high : : : : : : : : low

10. Precision of output information: the variability of the output information from that which it purports to measure.

high : : : : : : : : low

definite : : : : : : : : indefinite

11. Communication with the MIS staff: the manner and methods of information exchange between the user and the MIS staff.

harmonious : : : : : : : : dissonant

productive : : : : : : : : unproductive

12. Time required for new systems development: the elapsed time between the user's request for new applications and the design, development, and/or implementation of the applications systems by the MIS staff.

reasonable : : : : : : : : unreasonable

acceptable : : : : : : : : unacceptable

13. Completeness of the output information: the comprehensiveness of the output information content.

sufficient : : : : : : : : insufficient

adequate : : : : : : : : inadequate

Summary

14. How satisfied are you with your involvement and participation in the operation and ongoing development of information systems?

satisfied : : : : : : : : dissatisfied

15. How satisfied are you with the support and services of the MIS department?

satisfied : : : : : : : : dissatisfied

16. How satisfied are you with the information product itself?

satisfied : : : : : : : : dissatisfied

17. In summary, how satisfied are you with the *entire* information systems environment?

satisfied : : : : : : : : dissatisfied

Section V. Success Factors

PLEASE ANSWER ALL THE QUESTIONS ON THIS PAGE REGARDLESS OF WHETHER OR NOT THERE IS AN EDI SYSTEM IN YOUR COMPANY.

CONSIDER THE FOLLOWING ASPECTS OF AN INFORMATION SYSTEM. USING THE SCALE BELOW, INDICATE THE EXTENT TO WHICH EACH ASPECT INFLUENCES THE SUCCESS OF THE SYSTEM.

Not Applicable	*No Extent At All*	*Little Extent*	*Some Extent*	*Great Extent*	*Full Extent*
0	*1*	*2*	*3*	*4*	*5*

THE FIRST COLUMN OF NUMBERS RELATES TO YOUR EVALUATION OF EDI SYSTEMS, WHILE THE SECOND COLUMN OF NUMBERS RELATES TO YOUR EVALUATION OF INTERNAL INFORMATION SYSTEMS SUCH AS PAYROLL AND ACCOUNTS PAYABLE.

	EDI						INTERNAL					
System's Outcomes												
1. Improvement of your company's image in industry	0	1	2	3	4	5	0	1	2	3	4	5
2. Improvement in customer services	0	1	2	3	4	5	0	1	2	3	4	5
3. Increase in inter-corporate transactions	0	1	2	3	4	5	0	1	2	3	4	5
4. Enhancement of inter-corporate coordinative efforts	0	1	2	3	4	5	0	1	2	3	4	5
5. Increase in sales	0	1	2	3	4	5	0	1	2	3	4	5
6. Decrease in inventory, personnel, or transaction costs	0	1	2	3	4	5	0	1	2	3	4	5
7. Reduction in paper work	0	1	2	3	4	5	0	1	2	3	4	5
8. Improvement in capturing and controlling of data	0	1	2	3	4	5	0	1	2	3	4	5
System's Characteristics												
9. Overall cost-effectiveness of the system	0	1	2	3	4	5	0	1	2	3	4	5
10. Reliability of the system	0	1	2	3	4	5	0	1	2	3	4	5
11. Ease of use of the system	0	1	2	3	4	5	0	1	2	3	4	5
12. Adequacy of system's storage capacity	0	1	2	3	4	5	0	1	2	3	4	5
13. Adequacy of system's processing speed	0	1	2	3	4	5	0	1	2	3	4	5
14. Accessibility of the system	0	1	2	3	4	5	0	1	2	3	4	5
Quality of output												
15. Accuracy of output information	0	1	2	3	4	5	0	1	2	3	4	5
16. Relevance of report contents to intended function	0	1	2	3	4	5	0	1	2	3	4	5
17. Completeness of output information	0	1	2	3	4	5	0	1	2	3	4	5
18. Precision of output information	0	1	2	3	4	5	0	1	2	3	4	5
19. Reliability of output information	0	1	2	3	4	5	0	1	2	3	4	5
20. Timeliness of report delivery to users	0	1	2	3	4	5	0	1	2	3	4	5
Aspects Related to Users, MIS staff, and Top Management												
21. Overall support provided to users by MIS staff	0	1	2	3	4	5	0	1	2	3	4	5
22. Users' understanding of the system	0	1	2	3	4	5	0	1	2	3	4	5
23. Users' participation in the development and implementation	0	1	2	3	4	5	0	1	2	3	4	5
24. Training provided to users	0	1	2	3	4	5	0	1	2	3	4	5
25. Top management involvement in defining MIS policies	0	1	2	3	4	5	0	1	2	3	4	5

Section VI. Rankings

Using the items on the opposite page, please RANK the top five most important aspects that you feel influence the success of EDI and INTERNAL systems, 1 being the most important, 5 being the fifth most important aspect. In the space provided, write the numbers (1-25) of the most important aspect, second most important aspect, etc., for each type of system.

___	___	___	___	___		___	___	___	___	___
1	2	3	4	5		1	2	3	4	5
		EDI						INTERNAL		

Section VII. Overall Evaluation of Internal and EDI Systems

1. How do you rate the overall degree of success of internal systems such as payroll and accounts payable in your company?

Don't Know	*Extremely Unsuccessful*	*Unsuccessful*	*Neutral*	*Successful*	*Extremely Successful*
0	1	2	3	4	5

2. How do you rate the extent to which internal systems such as payroll and accounts payable in your company have achieved their objectives?

Don't Know	*No Extent At All*	*Little Extent*	*Some Extent*	*Great Extent*	*Full Extent*
0	1	2	3	4	5

3. How satisfied are you with internal systems such as payroll and accounts payable in your company?

Don't Know	*Extremely Dissatisfied*	*Dissatisfied*	*Neutral*	*Satisfied*	*Extremely Satisfied*
0	1	2	3	4	5

Please skip Questions 4-6 if there is currently no EDI program under way in your company.

4. So far, how do you rate the overall degree of success of the edi program in your company?

Don't Know	*Extremely Unsuccessful*	*Unsuccessful*	*Neutral*	*Successful*	*Extremely Successful*
0	1	2	3	4	5

5. So far, how do you rate the extent to which the edi program in your company has achieved its objectives?

Don't Know	*No Extent At All*	*Little Extent*	*Some Extent*	*Great Extent*	*Full Extent*
0	1	2	3	4	5

6. So far, how satisfied are you with the edi program in your company?

Don't Know	*Extremely Dissatisfied*	*Dissatisfied*	*Neutral*	*Satisfied*	*Extremely Satisfied*
0	1	2	3	4	5

THANK YOU VERY MUCH FOR YOUR TIME.

IF YOU WOULD LIKE TO RECEIVE A SUMMARY OF THE RESULTS OF THIS SURVEY, PLEASE FILL OUT THE FORM BELOW. OR IF YOU PREFER, INSERT YOUR BUSINESS CARD IN THE ENCLOSED POST-PAID ENVELOPE.

Name: ______________________

Title: ______________________

Company: ______________________

Address: ______________________

____

____

Appendix 4 - BASIC Program - Scales Conversion

```
10 DIM A$(25),B$(25),C$(25),D$(25),R$(30)
20 OPEN "r",1,"c:\foxbase\quest.txt", 153: REM original file
30 OPEN "r",2,"c:\procomm\quest.vvv", 153: REM modified file
40 FIELD 1, 153 AS X$
50 FIELD 2, 153 AS XX$
60 INPUT "Enter the no. of cases", N
70 FOR K= 1 TO N: REM n subjects
80 GET 1,K
90 YY1$=MID$(X$,1,42):YY2$=MID$(X$,43,30):YY3$=MID$(X$,124,28)
100 Y$=MID$(X$,73,51): REM read the 25 pairs of item plus the key= 1st char.
110 REM reversing satisfaction scale from 1-7 to 7-1
120 FOR I= 1 TO 30
130 R$(I)= MID$(YY2$,I,1)
140 NEXT I
150 FOR I= 1 TO 30
160 IF R$(I)="1" THEN R$(I)="7":GOTO 220
170 IF R$(I)="2" THEN R$(I)="6":GOTO 220
180 IF R$(I)="3" THEN R$(I)="5":GOTO 220
190 IF R$(I)="5" THEN R$(I)="3":GOTO 220
200 IF R$(I)="6" THEN R$(I)="2":GOTO 220
210 IF R$(I)="7" THEN R$(I)="1"
220 NEXT I
230 YY2$=""
240 FOR I= 1 TO 30:YY2$=YY2$+R$(I):NEXT I
250 REM converting the three versions into a common one
260 IF MID$(Y$,1,1)="1" THEN TY$=YY1$+YY2$+Y$+YY3$:GOTO 320 REM no change
required
270 FOR I= 1 TO 25
280 A$(I)=MID$(Y$,I*2,1):B$(I)=MID$(Y$,2*I+1,1): REM A holds EDI, B Internal
290 NEXT I
300 IF MID$(Y$,1,1)="3" THEN GOSUB 540: REM Version 3
310 IF MID$(Y$,1,1)="2" THEN GOSUB 400: REM Version 2
320 LSET XX$=TY$:PUT 2: REM write to new file
330 PRINT XX$
340 Y$="":Y1$="":TY$="": YY1$="":YY2$="":YY3$="":REM set variables to null
350 FOR I= 1 TO 30:R$(I)="":NEXT I
360 FOR I= 1 TO 25:A$(I)="":B$(I)="":C$(I)="":D$(I)="":NEXT I
370 NEXT K
380 CLOSE
390 END
400 REM convert version 2
410 FOR I= 1  TO 25:C$(I)=A$(I):D$(I)=B$(I):NEXT I
420 FOR I= 1 TO 8
430 A$(I+12)=C$(I):B$(I+12)=D$(I)
440 NEXT I
450 FOR I= 9 TO 14
460 A$(I-2)=C$(I):B$(I-2)=D$(I)
470 NEXT I
480 FOR I=15 TO 20
```

```
490 A$(I-14)=C$(I):B$(I-14)=D$(I)
500 NEXT I
510 FOR I = 1 TO 25: Y1$=Y1$+A$(I)+B$(I):NEXT I: REM reconstruct middle string
520 TY$=YY1$+YY2$+MID$(Y$,1,1)+Y1$+YY3$: REM reconstruct the whole string
530 RETURN
540 REM convert version 3
550 FOR I= 1 TO 6
560 SWAP A$(I),A$(I+6)
570 SWAP B$(I),B$(I+6)
580 NEXT I
590 FOR I = 1 TO 25: Y1$=Y1$+A$(I)+B$(I):NEXT I: REM reconstruct middle string
600 TY$=YY1$+YY2$+MID$(Y$,1,1)+Y1$+YY3$: REM reconstruct the wole string
610 RETURN
```