Title: Exploring the Links between Inter-organisational Systems and Flexibility

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ABSTRACT

The attainment of flexibility has become increasingly important for organisations. Previous research shows that information systems can provide flexibility. This study investigates, at an exploratory level, the proposition that IOS and flexibility are connected. The research method combined a postal survey and two case studies of inter-organisational networks.

A review of the literature shows that flexibility has never been operationally defined within the context of IOS. In carrying out the research flexibility is defined as 'the capacity to adapt'. In particular it is the ability to adapt along four dimensions; first, temporal, how long it takes an organisation to adapt; second, range, the extent to which organisations can adapt to foreseen and unforeseen circumstances; third, intention, whether the organisation is being proactive or reactive in its adoption and fourth; focus, whether the flexibility is gained internally within the organisation or by managing external relationships with trading partners.

The first part of the study finds some support for the proposition that the technologies used for IOS provide flexibility. The second part of the study finds that organisations are obtaining flexibility from using IOS. In particular IOS are improving the efficiency, responsiveness, versatility and robustness of organisations. These improvements are occurring both within organisations and across the value chain. The degree to which organisations gain flexibility from IOS differs.

Certain characteristics of organisations are found to have a positive relationship with the level of flexibility being gained from IOS. These are (i) adopting IOS for offensive competitive reasons, (ii) integrating the IOS plan with the IS plan, (iii) integrating the IOS plan with the business plan, (iv) initiating the adoption of IOS, (v) integrating IOS with other IS software in the organisation, (v) possessing high levels of internal IT expertise, (vi) operating in a competitive environment and (vii) longevity of IOS use. The size of an organisation is not found to be related to the degree of flexibility being achieved. Similarly the industry sector in which an organisation operates is not a good predictor of the extent to which IOS provide flexibility.

CHAPTER 1

Introduction

1.1 Introduction

This chapter outlines the main issues with which this thesis is concerned. The first section demonstrates how organisations now compete on the basis of new ground rules. Specifically, latter-day organisations need to be flexible (De Meyer et al., 1989; Lambert and Peppard, 1993; Das and Elango, 1995) so that they can adapt and change to fast moving and volatile environments (Harrison, 1994; Volberda, 1996; Hoogeweegen, Streng and Wagenaar, 1996).

Section 1.3 demonstrates that organisations have continually used information systems (IS) as tools to enable them to remain competitive (Earl, 1989; Eardley et al., 1997). Initially, information systems were used to cut costs (Avison and Fitzgerald, 1994) then to improve the quality of decision making (Ward and Griffiths, 1996) and now they are being used to help organisations achieve flexibility (Fitzgerald, 1990; Behrsin et al., 1994). A specific type of information systems which have the potential to aid the attainment of flexibility are inter-organisational systems (IOS) (Cash and Konsynski, 1985; Scala and McGrath, 1993). IOS are computerised systems that cross organisational boundaries. The key areas in which such systems aid flexibility are presented. The chapter then introduces the research objective for this study and concludes with a plan of the research.

1.2 Changing Competitive Environment

Time brings change, and as a result the earning capacity of any industrial concern peters out after a time (Schumpeter, 1949). By the 1980's environmental changes were becoming increasingly undefined, fast moving and numerous (Aaker and Mascarenhas, 1984). In the 1990's businesses have to cope with even more dynamic, incessant, and greatly magnified competitive pressures (Harrison, 1994). These pressures include the globalisation of markets, rapid technological change, shortening of product life cycles, and increasing aggressiveness of competitors (Volberda, 1996). In addition, organisations face the on-going pressure of customised demand (Hoogeweegen et al., 1996).

Combined, these changes have altered the ground rules of competition to the extent that 'the inevitability of rapid change is an accepted fact in this last decade of the millennium'(Das and Elango, 1995, pp60). One consequence for organisations, of these changes, is the elimination of long, stable periods in which sustainable competitive advantage is achievable. Instead, competition is increasingly characterised by short periods of advantage punctuated by frequent disruptions (D'Aveni, 1994). These periods may prove to be very short. Bahrami and Evans (1995) argue, based on a study of companies located in the Silicon Valley, that in order to survive organisations must perpetually re-calibrate their business models and product offerings. The new competitive climate is termed 'hypercompetition'; an environment in which firms continually disrupt the status quo to create a series of temporary advantages (D'Aveni, 1994).

The new competitive conditions require firms to respond in new ways. Organisations continually respond to change by competing on the basis of new strategic imperatives. To date, during this century organisations have competed with each other on the basis of three strategic imperatives; (i) efficiency, (ii) quality, and (iii) flexibility (Suarez et al., 1995). With the advent of scientific management, early in the 1900's, efficiency became the key strategic imperative. Around the middle of the century quality emerged as a new strategic imperative

in the marketplace. The third strategic imperative, flexibility, emerged as a result of the instabilities of the 1970s and the increased global competition in most world markets starting in the early 1980's (Piore and Sable, 1984). In today's environment a company's competitiveness is gauged by its position on each of the three strategic imperatives vis-à-vis its market requirements (Bolwijn and Kumpe, 1990). No single element is sufficient for competitive success (Allen and Boynton, 1991; Venkatraman, 1994).

As organisations compete in the 1990's cost-efficiency and quality are minimum requirements. Flexibility has become the new competitive battle area (De Meyer et al., 1989). The importance of flexibility is demonstrated by Lambert and Peppard (1993) who state that 'it is well recognised that responsiveness, flexibility and innovation will be key corporate attributes for successful organisations'. For some, flexibility has become 'a bedrock strategic dimension' (Das and Elango, 1995) that organisations need to increasingly concentrate on in order to achieve new forms of competitive advantage (Harrison, 1994; Upton, 1995b).

Volberda (1996), proposes that in the new mode of hypercompetition, competitive advantage cannot be predicted but only responded to more or less efficiently, ex post. Hence, superior organisations in hypercompetitive environments must generate superior adaptive capability. In essence, organisations must become more flexible.

While the concept of 'flexibility' is intuitively appealing it is not always clear what is meant by the term (Evans, 1991). In deriving a definition a problem is encountered due to the fact that flexibility is a multi-dimensional concept (Suarez et al., 1995). This means that an organisation can be simultaneously flexible in some areas and inflexible in others. Consequently, Suarez et al. (1995) argue that it is not entirely appropriate to talk simply of a 'flexible system'. None of the research to date on flexibility has attempted to outline systematically all of the dimensions of flexibility. In carrying out this research an important objective is

the mapping out and integration of all the different dimensions of flexibility highlighted in previous research. It is on the basis of these dimensions, that a definition of flexibility is derived.

1.3 Evolution of Information Systems

This section presents a brief overview of how information systems have evolved in organisations. The review shows that information systems have continually been used by organisations to improve their competitiveness. Initially, they were used to save costs, then to improve the quality of decision making and presently they are being used to aid the attainment of flexibility (Lucas and Olson, 1994, Eardley et al., 1997).

In June 1951, the U.S. Bureau of the Census purchased a computer called the Univac I. This machine was the first electronic computer produced by a business machine company specifically for business purposes. By 1958 Leavitt and Whisler, in a seminal article, predict that the advent of the computer and management science will significantly change the structure and processes of most corporations.

The evolution of information systems within organisations has been examined by many researchers (Wiseman, 1985; Earl, 1989; Ward and Griffiths, 1996). Over time, IS has evolved from a supportive number crunching role to a driving force affecting the competitive positioning of organisations (Earl, 1989). Ward and Griffiths (1996) propose a 'three-era model' to explain the evolution of information systems. These three eras are; data processing, management information systems and strategic information systems.

The purpose of data processing systems is to improve the operational efficiency by automating information-based processes. These early business computer systems were used to automate high volume routine tasks such as payroll

calculation, processing accounts receivable, etc. The systems introduced in these areas provided fast and efficient data processing and manipulation. The benefits of these transaction processing systems were essentially derived directly from the cost savings that resulted from the automation of previously labour-intensive manual process systems.

By the mid 1960's, management information systems started to appear. These early information systems were by-products of the existing data processing systems and had limited impact on management decision making. They were inflexible, constrained to manipulating transaction processing data, and not responsive to the information needs of the individual (Parker, 1989). These problems led to the development of other information systems such as decision support systems and executive information systems. The overall objective of all management information systems is to increase management effectiveness by satisfying information requirements. As such, the focus of these systems is on internal information management to aid decision making.

The early 1980's saw the proliferation of personal computers in organisations and dramatic improvements in telecommunications technology. These changes resulted in information technologies beginning to take on a new role in organisations, that of a strategic weapon (Earl, 1988). Wiseman (1988) argues that 'strategic information systems' represent a new information system variety, radically different in organisational use from those countenanced by the conventional perspectives of management information systems and decision support systems'. The aim of these systems is to improve competitiveness by changing the nature or conduct of business (Ward and Griffiths, 1996).

Improvements and changes in technology enabled the progression from one information systems era to the next. These technological improvements were reflected in the changing terminology being used in business. The term 'information technology' (IT) started to replace the terms 'data processing' and 'management information systems' as it captured the power and expanding

character of the technology (Rockart and Scott-Morton, 1984). Telecommunications was the essential element which distinguished information technology from information systems (Porter and Millar, 1985; Huff and Munro, 1985; Burns and McFarlan, 1987; Scott-Morton, 1988b). Earl (1989) defined the differences between information systems, information technology and information management (IM) as follows:

> Information system refers to the flow of information in an organisation and between organisations, encompassing the information the business creates, uses and stores.
>
> Information technology is the enabling mechanism, which facilitates the processing and flow of this information, as well as the technologies used in the physical processing to produce a product or provide a service.
>
> Information management comprises the planning, organisation and control of information resources

These definitions conceptualise a difference between the information a system produces, the machinery which makes the computation and delivery of that information possible and the management of the information resource. For the purpose of this research Earl's definitions are adopted.

1.3.1 Inter-organisational systems

The third era of information systems, strategic information systems, are usually built around telecommunication components (Suomi, 1994). Many exemplary cases of the use of IT for competitive advantage have been based on inter-organisational systems, a particular type of information system (Johnston and Vitale, 1988; Feeny, 1988; Ives and Learmonth, 1984; Keen, 1986; McFarlan, 1984). Some argue further that the majority of examples of competitive

advantage through IT in the literature have been inter-organisational systems (Runge and Earl, 1988; Hirschheim and Adams, 1991; Grover and Teng, 1994). For the purpose of this study inter-organisational systems are defined as:

> computer based information systems that facilitate the exchange of information electronically using telecommunications between different organisations' computer systems.

The importance of inter-organisational systems to businesses continues to grow. O'Callaghan et al. (1992) in their research on marketing channels, propose that inter-organisational systems employing IT may be the most important technological breakthrough in the channels of distribution since air transport. Konsynski (1993) argues that the use of inter-organisational systems for strategic success is set to continue. Indeed, he believes that the now familiar stories in the airline, hospital supply, and banking industries are not anomalies, but merely the tip of an emerging trend in new organisation alliances, boundary redefinition, and market structures.

While research on IOS has been on-going for over a decade many avenues for additional research have been highlighted. It has been suggested that there is 'a marked lack of empirical research studies that focus on the specific effects - if any - of IOS on business performance' (Venkatraman and Zaheer, 1994). One area on which to focus such future research is on the significance of IOS in supporting competitive strategies (Bakos, 1991a; Swatman and Swatman, 1992). Additional avenues for research might be the study of the relationships between organisations using IOS (Mackay, 1993) and how benefits are distributed between IOS participants (Cunningham and Tynan, 1993; Venkatraman and Zaheer, 1994).

Hence, while some research has been carried out in IOS, further avenues remain open. In particular, there is a need to study how the IOS affects the relationship between the trading partners. The next section shows that 'flexibility' has been

identified as a benefit of IOS both for individual firms and for the network as a whole. As such it is a variable which can affect the relationship between firms.

1.4 IOS and Flexibility

One of the potential benefits that IOS are believed to provide to organisations is flexibility (Cash and Konsynski, 1985; Scala and McGrath, 1993). The word 'flexibility' is not defined in either of these papers, rather it is assumed to be understood intuitively. Cash and Konsynski (1985, pp134) state that 'IOS will significantly contribute to enhanced productivity, *flexibility*, and competitiveness for many companies'. In 1993, Scala and McGrath (pp86) reiterate this belief and state that 'electronic data interchange, a subset of IOS, has significantly contributed to enhanced productivity, *flexibility*, and competitiveness in many companies'.

Others provide a context within which flexibility is created. Fynes and Ennis (1993) demonstrate, on the basis of a case study, that the flexibility of the organisation is enhanced by enabling a more responsive information provision. Picot et al. (1993) find that IOS increase flexibility by enabling a more timely response to customer requests. Thus, IOS are believed to increase the flexibility of organisations by increasing their responsiveness.

Another way in which IOS are believed to provide flexibility is by enabling the efficient boundaries of a firm to be shifted (Bakos and Treacy, 1986; Bakos, 1991b; Clemons and Row, 1992a). The effect of IOS is to allow closer integration of adjacent steps in the value-added chain through the development of electronic markets and electronic hierarchies (Malone, Yates, and Benjamin; 1987). This occurs due to the ability of IOS to dramatically reduce the cost of co-ordination while also increasing speed and quality (Davenport and Short, 1990; Malone and Rockart, 1992). One of the impacts of this increased co-ordination is the ability to reduce inventory costs along the entire value chain (Barrett, 1986).

This reduction in inventory improves flexibility because the lack of inventory enables organisations to produce orders which include any adaptations required by customers.

The possibility for closer co-ordination also holds the possibility of creating IT-enabled value-adding partnerships (Johnston and Lawrence; 1988). These partnerships enable organisations to compete together as a unit connected via IOS against larger vertically integrated organisations.

1.5 The Research Objective

Organisations are seeking flexibility as a strategic objective. Previous research has suggested that information systems, and in particular IOS, can provide flexibility. However, research to date on IOS has not operationally defined flexibility or specifically studied the relationship between IOS and flexibility. This study seeks to contribute to IOS research by addressing these issues.

The objective of this research is:

to examine the relationship between IOS and flexibility

Lucas and Olson (1994) in an examination of the effect of IS on organisational flexibility argue that a distinction can be made in the types of flexibility achievable. In particular, they argue that flexibility can derive from the technology itself and the use to which it is put. They call these two flexibilities technological and organisational. Cognisant of the difference between these two types of flexibility two separate research questions are devised:

RQ 1: to what extent does IOS technology provide flexibility?

RQ 2: to what extent does the use of IOS provide flexibility?

Other research on IOS finds that significant differences exist in the perceptions of disparate organisations regarding the levels of benefits they receive from information systems (Cash and Konsynski, 1985; O'Callaghan et al., 1992; Webster, 1995). In addition studies identify specific organisational factors which are significant in explaining these differences (Sabherwal and Vijayasarathy, 1994; Chismar and Meier, 1992; Swatman et al., 1994; Cox and Ghoneim, 1994; Holland et al, 1992; Swatman and Swatman, 1991; Johnston and Carrico, 1988; Premkumar et al., 1994). For the purpose of this research, it is proposed that since flexibility is a benefit of IOS, the same organisational factors might explain differences in the degree of flexibility achieved. The third research question is:

RQ 3: what organisational factors influence the variation in the degree of flexibility being achieved by different IOS participants?

1.6 Plan of Research

The plan of research is as follows. **Chapter 2** reviews the literature on flexibility. The perceived importance of flexibility to organisations is documented. A subjective/argumentative research method (Galliers, 1992) is used to define flexibility. The definition of flexibility proposed incorporates the multiple components of the concept. The literature demonstrates that organisations can achieve flexibility in different areas. Specifically, organisations can achieve flexibility by being more timely in response to changes, being able to react quicker, planning better for expected changes and providing an adaptive capability for unanticipated changes. The measurement of such flexibilities is achieved by ascertaining the efficiency, responsiveness, versatility and robustness of an organisation to environmental changes.

Next, the literature on how information systems can influence flexibility is reviewed. The chapter concludes by identifying IOS as one form of information system which can contribute to flexibility.

Chapter 3 presents a review of the literature on inter-organisational systems. The positive effect that information technology has had on inter-organisational transactions is demonstrated. This is followed by a definition of IOS. Next, on the basis of the literature, possible future research areas are presented and it is argued that this current study fits within the proposed research areas. The effects that IOS have on organisations are considered. These effects are structured on the basis of the four flexibility metrics; efficiency, responsiveness, versatility and robustness, proposed in chapter 2. Finally, the organisational factors that might enable organisations to achieve higher levels of flexibility are presented.

The research objective is presented and explained in **chapter 4.** Possible methods of conducting the research are presented in **chapter 5.** It is argued that a pluralistic research approach is the most appropriate for this study. This approach is justified on the basis of the exploratory nature of the research, the need for generalisable results along with the necessity to study the relationship between variables in more detail. The research methods chosen incorporate a mail questionnaire followed by case studies of two inter-organisational networks. The mail questionnaire was sent to a purposive sample of 338 organisations who were known users of IOS. Conducting the survey prior to the case studies enabled the researcher to document important relationships which could be explored in more depth during the two case studies.

The first part of the research consists of a survey which is presented in **chapter 6.** This chapter first presents a profile of the responding organisations. Next, the flexibility of the technology used for IOS is assessed. A conclusion is drawn that, while the technology serves the organisations well, it is not as flexible as firms believe it might be. While this is the case the technology is not seen as a constraining factor because time and money can remove any inflexibilities.

The extent to which inter-organisational of IOS is related to flexibility is assessed next. The majority of organisations surveyed believe that using IOS increases their organisation's flexibility. Chapter 6 also finds that certain organisational factors have a positive influence on the level of flexibility that an organisation gains from IOS.

Chapter 7 presents the findings of the two case studies which sought to investigate and expand on the findings of the survey. **Chapter 8** discusses the findings from both stages of the study in light of the research objective. Conclusions are drawn and recommendations for further research are outlined.

CHAPTER 2

Literature Review: Flexibility

2.1 Introduction

Chapter 1 illustrated that the attainment of flexibility has become an important, some argue essential, requirement for organisations. In researching flexibility a problem which arises continually is one of definition. Previous research (Eppink, 1978; Aaker and Mascarehas, 1984; Adler, 1988; De Leeuw and Volberda, 1996), in proposing definitions of flexibility acknowledge that it is not amenable to simple definition, since it is a multi-dimensional, (Suarez et al., 1995) polymorphous (Evans, 1991) concept. A reason for this is that even within one firm many different types of flexibilities and inflexibilities may exist concurrently.

This chapter (section 2.3) presents a review of the definitions so far proposed. Flexibility is the capacity to adapt. The study demonstrates that the ability to change can exist in four areas, or what Evans (1991) calls dimensions. First, in terms of time (Eppink, 1978; Gustavsson, 1984; Upton, 1994), second, with respect to foreseen and unforeseen changes (Krijnen, 1979; Carlsson, 1989; Eardley et al., 1997), third, the extent to which flexibility is obtained offensively or defensively (Evans, 1991; Avison et al., 1995; De Leeuw and Volberda, 1996) and, fourth, the degree to which flexibility is gained either internally within the organisation or externally (Ansoff, 1965; Das and Elango, 1995).

It is proposed that an inclusive definition of flexibility be adopted, which incorporates within one definition the different dimensions of previous studies. As such it is proposed that flexibility is obtainable in four areas; temporal, range,

intention and focus. These dimensions are areas within which flexibility can be sought.

While the dimensions provide target areas where it is possible for organisations to gain flexibility they do not measure the extent to which it is being obtained. Section 2.5 outlines four measures of flexibility; efficiency, responsiveness, versatility and robustness. These four provide tools to measure the extent to which an organisation achieves flexibility along the temporal and range dimensions of flexibility. The intention and focus dimensions are situation based and are measurable in terms of the specific variable being investigated. For this research inter-organisational systems are studied. The intention dimension is assessed in terms of whether the adoption of IOS is initiated by an organisation or not. The focus dimension is measured by ascertaining the extent to which changes brought about by IOS are internal or external to an organisation.

The focus of this research is on IOS, a type of information system. Section 2.7 outlines how information systems and information technology can affect the flexibility of organisations. The technology possesses capabilities which enhance the flexibility of an organisation (Avison et al., 1988; Lucas and Olson, 1994; Duncan, 1995a). However IT and IS may also be the cause of rigidity and inflexibility in organisations (Fitzgerald, 1990, Allen and Boynton, 1991; Avison et al., 1995).

2.2 Organisational Flexibility

Flexibility is not a new concept, it has been researched in business by economists for over 50 years (Hart, 1937; Stigler, 1939). The early focus of research in flexibility is on the ability of a production facility to produce something other than that originally intended. The acceptance by management of the importance of flexibility to a business was demonstrated as early as 1975 by Steers who found that flexibility was the evaluation criterion most used to assess

organisational effectiveness. The long established recognition of the importance of flexibility in organisations is further supported by Sayer (1989) who argues that capitalist industry has always combined flexibility with inflexibility, and what are possibly emerging now are new permutations of each rather than a simple trend towards greater flexibility.

The literature shows that flexibility is seen as a 'good thing' (Adler, 1988; Avison et al., 1995). However flexibility is not a 'free good' (Carlsson, 1989). Specifically, in economics, it has been shown that production plants that wish to have the ability to produce more than one good will have a higher unit cost curve than a plant specialising in the production of a single good (Stigler, 1939). In a more recent study, Das and Elango (1995) outline that there can be disadvantages to strategic flexibility in the forms of increased costs, increased stress on employees and a lack of organisational focus.

While flexibility may have associated costs, organisations continue to seek it in order to increase their competitiveness (Lambert and Peppard, 1993). Indeed Carlsson (1989), on reviewing business-related literature argues that flexibility, specifically in the guise of adaptive manufacturing technologies, has become as important a determinant of competitiveness as costs. Thompson (1993) suggests that there is evidence that greater flexibility is needed in the strategic process now compared with the 1970's. Further evidence of the importance of flexibility to organisations is provided by Avison et al. (1995) who believe that flexibility has become so important to organisations that it may have a role as a critical success factor in its own right. Suarez et al. (1995) are in no doubt about the importance of flexibility and believe that today's world demands more flexibility. They argue the real issue concerning flexibility is for organisations to be able to understand and manage it strategically.

It has been shown that flexibility is a concept which has concerned business researchers for over half a century. The importance of flexibility is increasing and it is now seen as an essential element for competitive survival by some

organisations. Yet, Suarez et al. (1995) point out that the real issue concerning flexibility is to be able to understand the concept.

2.3 Definition of Flexibility

Strategic flexibility as a concept has been under study for at least two decades. Eppink (1978), concludes that little theoretical or empirical discussion is available on the subject. By 1984 the situation had changed little. Aaker and Mascarenhas find that the literature fails to structure comprehensively the many alternative approaches to flexibility. Similarly, Adler (1988) studying manufacturing, proposes that no consensus has yet emerged as to the most appropriate definition of flexibility. As recently as 1996, De Leeuw and Volberda conclude that the meaning of flexibility is still ambiguous. This section provides a definition of flexibility which encapsulates the different aspects of previous research. In doing this the study outlines a definition of flexibility which is encompassing enough to remove ambiguity.

While the use of the word 'flexibility' is ubiquitous, it is not always clear what is meant by the term (Evans, 1991). One reason why flexibility is so difficult to define is that definitions are often coloured by particular managerial situations or problems (Upton, 1994). Definitions available propose that flexibility is an ability (Bolwijn and Kumpe, 1990; Monteiro and Macdonald, 1996) or capability (Eppink, 1978; De Leeuw and Volberda, 1996) which an organisation possesses to change (Gustavsson, 1984; Anderson, 1993) or react (Upton, 1995a).

Suarez et al. (1995) argue that flexibility is a multi-dimensional concept in the sense that an organisation can be very flexible in some ways and less flexible in others. Consequently, they argue, it is not entirely appropriate to talk simply of a 'flexible system'. Evans (1991) supports this argument and concludes that the concept of flexibility is polymorphous, having a number of different meanings in various contexts. In order to progress research on flexibility, Upton (1994) argues

that what is required is the identification of the multiple types of flexibility so that they can be split into component parts which can be prioritised, measured and improved. Reaching such a commonality of purpose is, he argues, a critical step in any improvement path, be it for quality, productivity, or flexibility.

For the purpose of this research flexibility is defined as 'the capacity to adapt'. The word capacity is chosen in preference to capability because it better characterises the multi-dimensional element of flexibility. Defined in the Concise Oxford Dictionary (Sykes (Ed.), 1979) capacity is 'the power of containing, receiving, experiencing or producing', while capability is 'the power to do something'. The definition outlined above only possesses meaning when placed within specified contexts. These contexts are the areas, or dimensions, within which flexibility can be achieved.

2.4 Dimensions of Flexibility

The concept of 'dimensions' builds on the work of Evans (1991) who defines flexibility as consisting of two dimensions, temporal and intentional. In expanding the framework this research identifies four dimensions of flexibility which exist in the literature (Figure 2.1). The first of these is temporal; how long it takes an organisation to adapt. The second is range; the number of options that an organisation has open to it for change that was foreseen and the number of options it has available to react to unforeseen change. The third is intention; whether the organisation is being proactive or reactive in its adoption. The final dimension of flexibility is focus; specifically whether the flexibility is gained internally within the organisation or by managing external relationships with trading partners.

Dimension of Flexibility	Scope
Temporal	Short term - medium term - long term
Range	Foreseen circumstances - Unforeseen circumstances
Intention	Offensive - Defensive
Focus	Internal - External

Figure 2.1: Dimensions of flexibility

2.4.1 Temporal

The first dimension of flexibility, temporal, can be described in terms of the length of time that it takes an organisation to respond to environmental changes. Eppink (1978), in studying strategic flexibility, argues that there exists a typology of environmental change: operational, competitive, strategic. He argues that this typology can be mapped onto flexibility to conceive three types of flexibility: operational, competitive and strategic. Gustavsson (1984), studying flexibility in manufacturing, argues that it is essential to identify 'the critical time perspective or perspectives'. He divides flexibility on a time basis into three categories, operational, tactical and strategic. Operational problems are short-term, e.g. replanning due to breakdown of a machine or unexpected shortage of a raw material. Tactical problems are medium-term e.g. changes in design or rate of production. Strategic problems are long-term, e.g. investments in machinery or business expansion.

Upton (1994), also proposes three degrees of temporal flexibility. For him operational flexibility is the ability to change day-to-day, or within a day, as a matter of course. Tactical flexibility is the ability to occasionally change or adapt, say every quarter, and to make changes which, on average, demand some effort and commitment. Strategic flexibility is the ability to make one-way, long-term changes which, in general, involve significant change, commitment or capital and which occur infrequently, say every few years or so.

The temporal dimension of flexibility is the ability of an organisation to adapt within a given time frame.

2.4.2 Range

The second dimension of flexibility is the degree to which an organisation can adapt to foreseeable and unforeseeable changes. Eppink (1978) propose that flexibility is a strategic response to the unforeseen. Krijnen (1979) provides a definition which incorporates both foreseen and unforeseen environmental changes. He argues that 'a flexible firm' possesses the ability to adapt to ensure its continued viability. One way to achieve this is by planning for developments in the environment which are likely to occur (foreseeable events). A second way is by adapting to circumstances, events taking place in the environment, which were by no means predictable or foreseeable.

Carlsson (1989) argues that two types of flexibility exist, which he calls Type I and Type II flexibility. Type I flexibility relates to the concept of risk and involves planning for foreseeable events. Type II flexibility relates to uncertainty and how to make good use of new disclosed opportunities and to rapidly respond to uninsurable (unforeseen) changes in the market place.

The second dimension of flexibility measures the range of options available to an organisation in responding to environmental change. This dimension is comprised of two areas, the range which has been planned for and the range which is possible for events that were not planned for. Foreseen to unforeseen represent the two ends of the continuum for this dimension of flexibility.

2.4.3 Intention

The third dimension of flexibility acknowledges that, while change in the environment is inevitable, organisations are not helpless against it. This dimension of flexibility is the degree to which organisations take an offensive or defensive stance towards flexibility (Avison et al., 1995; Evans, 1991). Those who take an offensive role attempt to control the changes that are occurring in the environment in such a way that they can gain a competitive advantage. On the other hand defensive organisations react to changes after they have occurred and try to minimise the effect of the change. This attempt to manage flexibility has also been described as active or passive (Eppink, 1978; De Leeuw and Volberda, 1996).

2.4.4 Focus

The fourth dimension of flexibility is the area in which the flexibility is created. Ansoff (1965) suggests two types of strategic flexibility, internal and external. In so doing he provides the earliest reference to this dimension of flexibility. Das and Elango (1995) adopt this dimension of flexibility and provide a list of areas where both of these dimensions can be obtained. The significant internal areas which can create internal flexibility are manufacturing, employee flexibility and organisational structure. The main avenues for obtaining external flexibility include suppliers, alliances, and multinational operations. The next section discusses the three internal areas where flexibility can be obtained. The subsequent section discusses areas in which external flexibility can be obtained.

2.4.4.1 Internal

One area within organisations where it is proposed that the attainment of flexibility is possible is in the manufacturing process (Adler, 1988; Slack and

Correa, 1992; Anderson, 1993). It is argued that the achievement of flexibility in manufacturing is a critical source of competitive advantage for many firms (Upton, 1994). This can be brought about by creating the 'flexible factory' (Upton 1995b). Some believe that new flexible manufacturing technologies will bring revolutionary change by eliminating the manufacturing flexibility advantages historically held by small firms and manufacturing efficiency advantages historically held by large firms (Elango and Fried, 1993).

Human resource management is a second area through which an organisation can create flexibility. Specific avenues for attaining flexibility are by permitting teleworking (Lloyd, 1990) and by substituting part-time, contract, and other 'contingent' workers for more expensive full-time employees (Harrison, 1994). The importance of the human element in creating flexibility is shown by Suarez et al. (1995) who finds that high worker involvement and flexible wage schemes provide manufacturing organisations with more flexibility than the flexible information technology they use. This finding is supported by Upton (1995b) who finds that operational flexibility is determined primarily by a plant's operators and the extent to which managers cultivate, measure, and communicate with staff. Equipment and computer integration are secondary.

A third way in which organisational flexibility can be provided is through organisational structures. Krijnen (1979) proposes that organisations can obtain the level of flexibility desired by altering their organisational structure to suit the competitive situation they face. Bolwijn and Kumpe, (1990) believe that the appropriate organisational design is based upon the creation of fast feedback loops, enabling processes to quickly react to changes, while retaining reliability. Volberda (1996) sees organisational structure as being central to flexibility and the purpose of his research is to try to derive an organisational structure that is flexible to enable firms to compete in the hypercompetitive environments of the 1990's.

2.4.4.2 External

Ansoff (1965) proposes that one way to obtain external flexibility is for an organisation to diversify into different products and markets. Subsequently external flexibility is associated with subcontracting production to provide organisations with the flexibility to step up or step down production (Aaker and Mascarenhas, 1984).

The trend towards outsourcing coincided with a trend by organisations to focus on their 'core competencies' (Peters and Waterman, 1982, Hamel and Prahalad, 1994). In this way flexibility is seen to be achievable through 'diverse specialisation' (Piore and Sabel, 1984). This occurs where each firm focuses on what it does best and leverages the capabilities of other entities for complementary activities (Bahrami and Evans, 1995). An organisation obtains flexibility by increasing the levels of external flexibility available to it. This is done by increasing the ability of the organisation to switch at short notice between the products its suppliers produce and also the ability to switch suppliers if necessary.

The networked organisation (Thorelli, 1986; Miles and Snow, 1986) is the concept used to describe situations where individual organisations concentrate on their core competence and use other firms where required to enable a complete product to be made. Cooke (1988), believes that organisations working together as a network achieve 'flexible integration'. That is the network provides greater flexibility than that achievable through the vertical integration of a single organisation. One of the main reasons for this is that individual firms in the network can be added or dropped rapidly as required. As such the network implies a narrower range of output at the level of the individual firm, but a great degree of flexibility at the level of the network (Sayer, 1989). Therefore an individual organisation in a network obtains a lower level of internal flexibility while at the same time obtaining an increased level of external flexibility.

The importance of creating this type of external flexibility is exemplified by Powell (1990) who argues that network forms of organisations may in fact be in the process of becoming the *signature* institutional form of this era - precisely because they offer managers the best working solution to the challenges posed by the increasing need for flexibility. Harrison (1994) believes similarly that the network form is especially appropriate for attaining flexibility. Eloranta et al. (1995) argue the point more forcefully in saying that fast, flexible and co-operative supply chains are a key issue for the survival of organisations.

The idea of the network and the external flexibility it creates for organisations is central to new concepts emerging such as 'adaptive channels' (Narus and Anderson, 1996) and 'quick response' (Richardson, 1996). Adaptive channels are situations where organisations have worked with their distribution channels to make them more flexible and responsive (Narus and Anderson, 1996). Quick response is a strategy for linking retailing and manufacturing operations in order to provide the flexibility needed to quickly respond to shifting markets (Hammond 1990).

The fourth dimension of flexibility, focus, demonstrates that the attainment of flexibility is no longer confined to just within the boundaries of an organisation. Flexibility can also be obtained externally and one way of achieving this is through external links with other organisations, such as suppliers, customers and distributors. These links provide an additional way for organisations to achieve flexibility. As such the fourth dimension of flexibility shows that external trading partners and the links that are created with them can be a source of flexibility for organisations.

2.4.5 Combined Dimensions

In the preceding sections the four dimensions of flexibility were outlined separately. However, it should be noted that many authors associate the four

dimensions. These combinations are outlined in Figure 2.2. While several authors link different individual dimensions, the four together have never been comprehensively discussed before now.

	Dimensions of Flexibility			
References	**Temporal: Operational to Strategic**	**Range: Foreseen or Unforeseen**	**Intention: Offensive or Defensive**	**Focus: Internal or External**
Ansoff (1965)			*	*
Eppink (1978)	*		*	
Krijnen (1979)		*	*	
Carlsson (1989)	*	*		
Evans (1991)	*		*	
Das and Elango (1995)	*	*		*
Avison et al. (1995)	*	*		
De Leeuw and Volberda (1996)			*	*

Figure 2.2: Combined Dimensions of Flexibility

The four dimensions outline areas where organisations can achieve flexibility. Their purpose is the provision of a broad framework highlighting areas in which flexibility can be achieved. As such they attempt to provide 'flexibility thrusts' in a similar way to how Wiseman (1985) outlines 'strategic thrusts'. However, the flexibility thrusts are unlike Wiseman's in that they are not mutually exclusive.

The dimensions identify fruitful regions in which flexibility can be pursued. Within these a need exists to measure the extent to which flexibility is being achieved. The following section outlines the metrics of flexibility which have been identified in the literature.

2.5 Metrics of Flexibility

The fact that flexibility has different meanings in different contexts has compounded the problem of developing a metric for flexibility. Adler (1988) argues that a difficulty exists in quantifying the 'value of flexibility', which in turn prevents the concept of flexibility from being integrated into a standard financial methodology. Aaker and Mascarenhas (1984), investigating strategic flexibility, in that flexibility levels are rarely monitored or measured and when they are, judgements tend to be subjective and informal. The measurement of flexibility in manufacturing is similarly ill-defined with few prescriptions for assessment (Anderson, 1993; Upton, 1994).

The measurement of flexibility, in order to be meaningful, must be measured against a given context. For De Leeuw and Volberda (1996) the context is time, for Adler (1988) it is against a 'backdrop of stabilities' and for Upton (1994,1995a) it is an organisation's ability to change or react with little penalty in time, effort, cost or performance. The literature on flexibility has proposed numerous standpoints from which to measure flexibility. Four metrics emerge from a review of the literature; efficiency, responsiveness, versatility and robustness (Figure 2.3).

2.5.1 Efficiency

In researching manufacturing flexibility Anderson (1993) defines 'flexibility' as the ability of the production system to accommodate change with minimal degradation of performance. Upton (1994, 1995b) describes efficiency as the ability to maintain uniformity of some performance measure, such as yield or quality, within a range of possible production. Thus, in the manufacturing literature, one metric of flexibility is the ability of the organisation to maintain efficiency while accommodating or adapting to change.

Classification	Reference	Flexibility
Efficiency	Sabel (1982)	Produce a range of goods at the lowest total cost
	Anderson (1993)	Accommodate change with minimal degradation of performance
	Upton (1994, 1995b)	Uniformity on a performance measure
	Avison et al (1995)	Improves the quality of internal resources
Responsiveness	Eppink (1978)	Response capacity
	Bolwijn and Kumpe (1990)	The ability to change quickly
	Evans (1991)	Increase the speed of manoeuvre, expedient capability
	Upton (1994)	Mobility
	Lucas and Olsen (1994)	Respond quickly
	Upton (1995a)	Ability to change quickly
	Avison et al (1995)	Speed of response, agility, manoeuvrability, responsiveness
	Das and Elango (1995)	Nimble and quick, timely and appropriate
	De Leeuw and Volberda (1996)	Responsiveness, agility, suppleness, rapidity
	Volverda (1996)	Responsiveness
	Monteiro and Macdonald (1996)	Ability to respond and change
Versatility	Krijnen (1979)	Take account of developments in the environment which are likely to occur
	Gustavsson (1984)	Adaptable and capable of change
	Evans (1991)	Susceptibility to modification, liquidity, malleability, pliability, extend scope of manoeuvre
	Sabel (1982)	Capacity to produce a range of different products
	Upton (1994, 1995b)	Accommodate a large range on the dimension of change Uniformity on a performance measure
	Avison et al (1995)	Range of activities that a system can perform, adaptability, versatility
Robustness	Eppink (1978)	Respond successfully to unforeseen environmental change
	Krijnen (1979)	Adaptable to unpredictable or unforeseeable circumstances
	Aaker and Mascarenhas (1984)	Ability to adapt to substantial, uncertain, and fast-occurring environmental changes
	Harrigan (1985) Carlsson (1989)	Ability of firms to reposition themselves in a market, change their game plans or dismantle their current strategies
	Best et al. (1986)	The maintenance of flexibility under conditions of uncertainty
	Evans (1991)	Corrigibility, capacity for new situations
	Lucas and Olson (1994)	Ability to adapt to new or changing requirements
	Avison et al (1995)	Necessary for survival, resilience, robustness Attribute which enables an organisation to react to developments Ability to prepare for and manage an uncertain future in a proactive way The concept of flexibility is most closely related to, but distinguishable from, robustness.

Figure 2.3: Metrics of Flexibility

In the information systems literature Avison et al. (1995) propose that flexibility can be measured in terms of the extent to which it improves the quality of

internal resources. The capability to react in an efficient manner is seen to be a key component of flexibility. These efficiencies are amenable to measurement and constitute the first metric of flexibility.

2.5.2 Responsiveness

The ability to respond to change within an appropriate time frame is an important metric of flexibility. Eppink (1978), in his review of strategic flexibility, proposes that one of two options which an organisation has open to it is to increase its response capacity to unforeseen environmental change. Bolwijn and Kumpe (1990) believe that to respond is the ability to 'change quickly' in response to changes. Evans (1991) calls this responsiveness 'an expedient capability' to deal effectively with capricious situations.

Upton (1994) defines internal manufacturing flexibility in terms of three dimensions -range, mobility and uniformity. The second of these dimensions, mobility, relates to responsiveness which he defines as the extent to which systems can move within a range with minimal transition penalties. In a subsequent paper he proposes a similar view, that flexibility is the ability of a plant to change between process states quickly (Upton, 1995a).

Avison et al. (1995) propose that the flexibility of an information system is typically described in terms of two dimensions; temporal and range. Temporality is defined in terms of speed of response. Das and Elango (1995) define responsiveness as the nimbleness and swiftness of an organisation to explore external opportunities, while reducing the impact of threats.

De Leeuw and Volberda (1996) suggest that at an intuitive level organisational flexibility roughly means mobility, responsiveness, agility, suppleness or litheness. From this intuitive definition it appears that the underlying theme of flexibility is an ability to respond when confronted with change. Volberda (1996)

outlines one of the metrics of flexibility as the rapidity with which organisations can implement procedures to respond to changes. Similarly, Monteiro and Macdonald (1996) propose that organisational flexibility is the ability to respond and to change.

In the preceding literature, flexibility is characterised as an ability to react to change with a speedy response. This capacity of flexibility can be measured using a metric of responsiveness. The responsiveness of the organisation is evaluated in relation to the time it takes to adapt to new circumstances.

2.5.3 Versatility

Responsiveness measures speed while versatility measures the extent to which the organisation has planned for, and can respond to, environmental change. Moreover, versatility is a measure of the range of activities that the organisation has contingently planned for. These plans are formulated on the basis of changes that could be foreseen.

Krijnen (1979) argues that strategic flexibility possesses elements which prepare for the foreseen and provide avenues to react to the unforeseen. Specifically, in the case of the foreseen, he argues that a flexible organisation alters itself by taking into account developments in the environment which are likely to occur. In this way the organisation builds up its versatility levels. Gustavsson (1984) puts the concept more succinctly as the ability of an organisation to be adaptable and capable of change. The dimension of the change, i.e. foreseeable or unforeseeable, is not specified by Gustavsson (1984) and has been interpreted to mean foreseeable changes.

Evans (1991), in looking at strategic flexibility, outlines three main contexts within which flexibility is used; yielding to pressure, capacity for new situations and susceptibility of modification. The 'susceptibility of modifications' is the

ability of an organisation to modify itself to cope with changes, as such it equates to the versatility measure being outlined here.

In the manufacturing literature versatility is often measured in terms of 'range'(Sabel, 1982). Examples of possible manufacturing ranges are; the range of component sizes that can be processed, the range of volumes of output for which a plant is profitable, or the range of products which may be produced (Upton, 1994). In information systems flexibility is defined by Avison et al. (1995) along the dual dimensions of speed and range of activities. The concept of versatility is implied by the use of the words 'possible range of activities that the information system can perform'.

Thus, versatility measures the ability of an organisation to have flexibility within a specific range of possible future options which the organisation has allowed for, or planned for, to accommodate foreseen future changes. That range is determined by the planning capabilities of the organisation. Versatility measures the flexibility which an organisation possesses to react to changes in the environment which the organisation could envisage happening.

2.5.4 Robustness

Robustness is the ability to respond successfully to unforeseen environmental change (Eppink, 1978). This metric of flexibility can be compared with versatility, the ability to respond to foreseen events (Krijnen, 1979). The nature of the unforeseen changes are defined by Aaker and Mascarenhas (1984) as substantial, fast-occurring changes which take place in an uncertain environment.

Strategic flexibility is defined as a firm's ability to reposition itself in a market or to change its strategies when its customers cease to be attractive (Harrigan, 1985). This definition is later adopted by Carlsson (1989). It can be argued that

the ability to change strategy, or one's customer base, represents a response to unplanned for and unforeseeable change.

Best et al. (1986) propose the concept of robustness analysis which has as its central concern the maintenance of flexibility under conditions of uncertainty. They believe that plans are robust to the extent that they contribute to anticipated satisfactory performance of a large number of configurations under many futures. Robustness is defined as the ability to maintain flexibility in a future which cannot be predicted or foreseen with any degree of certainty. Evans (1991) calls this aspect of flexibility the capacity for new situations. Lucas and Olson (1994) define it as the ability to adapt to new or changing situations.

Flexibility has different aspects such as adaptability, resilience, robustness, agility, versatility, manoeuvrability, and responsiveness (Avison et al., 1995). However they conclude that 'the concept of flexibility is most closely related to, but distinguishable from, robustness'. Robustness is a measure of the ability of the organisation to be flexible in relation to unforeseen changes (Rosenhead et al., 1986). It measures the capability of the firm to react to changes which had not been planned for (Rosenhead, 1989).

2.6 Relationship of Metrics of Flexibility with the Dimensions of Flexibility

The four metrics of flexibility outlined; efficiency, responsiveness, versatility and robustness, measure two of the dimensions of flexibility (Figure 2.4). Specifically efficiency and responsiveness measure the temporal dimension while versatility and robustness measure the range dimension. Efficiency measures the degree to which organisations meet the challenge within the time constraints imposed and responsiveness measures the time it takes organisations to adapt to new circumstances. Versatility relates to the capability of the organisation to

respond to situations which it has foreseen and robustness is the ability of the organisation to adapt and respond to changes which it did not foresee.

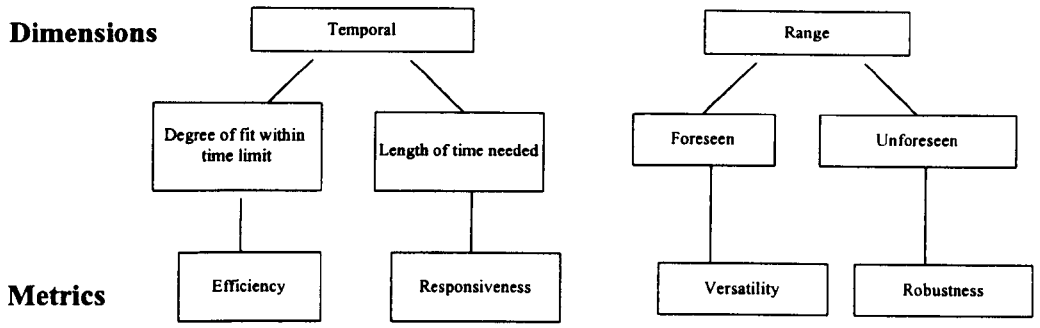


Figure 2.4 : Link between dimensions and metrics of flexibility

The operationalisation of the four metrics of flexibility which measure the temporal and range dimensions will be contingent on the specific facet that is being measured. For example, responsiveness measures in manufacturing might be production line changeover time, while for human resources it might be the time taken to retrain workers. Therefore, in attempting to measure the flexibility of an organisation, it is essential to specify the exact variable being investigated so that meaningful measures of efficiency, responsiveness, versatility and robustness can be derived. In this research inter-organisational systems are studied and in chapter 3 each of the four metrics are operationalised with respect to IOS.

In choosing the specific variable to be investigated, the context of the third and fourth dimensions of flexibility, intention and focus become defined. That is to say, intention and focus are situational attributes. By defining the area of study, the extent to which the intent was proactive or reactive and the extent to which the focus was internal or external is determined. For example, each organisation initially adopts IOS either proactively or reactively and this can be used to define the intention dimension of flexibility.

In relation to information systems, the fourth dimension, focus, is determined by the scope of the system. In this study inter-organisational information systems are being researched whose scope extends beyond a single organisation. IOS by definition operate both within the organisation and extend beyond it. This results in these systems being focused concurrently both internally and externally. As such IOS affect both the internal and external components of the focus dimension of flexibility.

In the next chapter IOS are examined. Prior to this the next section examines the impact that IS in general have on flexibility. Arguments are presented to demonstrate that IS may have both a positive and a negative impact on flexibility.

2.7 Technological Flexibility

Study of the effect that IT can have on organisational flexibility is relatively recent. Aaker and Mascarenhas (1984) do not explicitly recognise the capability of information technology to provide flexibility. They highlight research and development, finance, operations, marketing, international and management structures as areas that can be targeted to increase flexibility. IS are not mentioned as a distinct area through which flexibility can be obtained. Suarez et al. (1995) argue that information systems affect flexibility but they subsequently exclude it as a variable to investigate in their study, due to time constraints.

2.7.1 Positive impact of IT on flexibility

Lucas and Olson (1994) in a paper entitled 'The Impact of IT on Organisational Flexibility' argue that IT contributes to organisational flexibility in three ways.

First, by changing the nature of organisational boundaries and the time when work occurs. Second, by altering the nature and pace of work and third, by helping firms respond to changing market conditions.

Specific components of information technology have been documented as sources of flexibility. Shim and McGlade (1984) propose that the new technology of personal computers and fourth generation languages will make possible more flexible planning models than the previous generation of technology allowed. Similarly, Avison et al. (1988) propose that fourth-generation languages and prototyping allow more flexibility in the development of information systems. Currently, object oriented technology is believed to be developing as an effective way to handle the demands of flexibility and an uncertain future (Prager, 1996).

One area specifically where information technology might provide flexibility is through the creation of IS architectures that provide the foundation for rapid response to changing market conditions (Allen and Boynton, 1991). In a review of the literature, Duncan (1995a) proposes that the potential value of IT infrastructure has been discussed in the literature in qualitative terms such as 'flexibility' and 'responsiveness'. Monteiro and Macdonald (1996) demonstrate, using the case of the airline reservation systems, that the IS are a resource which provide an element of flexibility in airline strategy. On the basis of this case study they conclude that the underlying IT architecture which an organisation adopts can be a tool which positively provides flexibility to an organisation.

The capability of IS are not confined to within the organisation. IS also enable the creation - via technology - of more flexible links with trading partners. In discussing the dimensions of flexibility above, the possibility to create flexibility via closer relationships with other organisations in the form of networks was highlighted. Venkatraman (1994) argues that IT has become a fundamental enabler in creating and maintaining a flexible business network. It enables the network by facilitating rapid information exchange between firms (Harrison,

1994; Richardson, 1996). In order to exchange information between organisations, a technological structure must exist. Boynton (1993) postulates that organisations who wish to compete effectively in the competitive environment of today need to develop cross-organisational information processing capabilities which are flexible, reusable, modular, general purpose and open to links with other platforms that exist either inside or outside the organisation. Therefore, the attainment of external flexibility is to some degree dependent on the information technology links that are created and maintained between organisations who trade together. Information systems that provide such links are inter-organisational systems and are discussed in more detail in chapter 3.

IT can be an enabler of organisational flexibility. First, specific types of information technology provide flexibility by providing more flexible ways of doing things. Second, the IS infrastructure can be designed so as to provide flexibility by allowing the organisation to adapt the information systems to new competitive environments. This adaptation can be internal or through information systems that link the organisation with its trading partners. Thus, information systems provide the capability for organisations to obtain both internal and external flexibility.

2.7.2 Negative impact of IT on flexibility

Information technology does not always have a positive impact on organisational flexibility. Indeed, some have argued that information technology has often been a cause of rigidity and inflexibility in organisations (Allen and Boynton, 1991; Lambert and Peppard, 1993; Avison et al., 1995). The inflexibility of technology is highlighted in The Economist (1990) which states that:

> 'today, businesses have discovered an even more disconcerting problem: markets change, but computer systems do not'.

The potential of information technology to have a negative impact is documented in the literature relating to manufacturing flexibility. Sayer (1989) proposes that manufacturing flexibility derives more from social innovations in actual working relationships, between workers, divisions and firms than from technical developments in information technology. This point is supported by Suarez et al. (1995) who discover that manufacturing plants with more programmable automation end up being the less flexible plants. Upton (1995b) in a study of 61 North American factories manufacturing fine paper finds that there is no direct correlation between the degree of computer integration and an increase in the degree of operational flexibility.

The adoption of information technology does not automatically provide an organisation with increased levels of flexibility. Indeed, it maybe the direct cause of a decrease in the levels of organisational flexibility. This is shown by Upton (1995b) who observes that in some of the paper mill plants he analysed the range of products that could be produced by a plant often fell by 20% to 30% after the mill made a major investment in computer integrated manufacturing.

Boynton (1993) argues that the reason for the inflexibility is that existing information architectures are geared towards particular competitive conditions and that new systems for new conditions contain an organisational change challenge. The basis of his argument is that the 'old' information processing capabilities are not designed to meet today's challenge of responding to the dual competitive requirements of rapid product customisation and production/distribution efficiency. Eardley et al. (1997) argue in the case of strategic information systems that certain 'rigid' information systems have *inhibited* the ability of organisations to exploit business opportunities by preventing a change in business strategy.

Research which has been carried out on flexibility in information systems has been largely confined to examining the systems development process. The focus of this research is on proposing that additions or radical changes to existing

systems development methodologies are required due to the inability of existing methodologies to design flexible information systems (Avison and Fitzgerald, 1995; Fitzgerald, 1990; Avison et al., 1995). One proposed way to overcome this inflexibility is to carry out a technique called 'flexibility analysis' (Fitzgerald, 1988). Another way to overcome the problem is to use a systems analysis methodology such as MultiView which gives the idea of flexibility serious consideration (Avison and Wood-Harper, 1991). Eardley et al. (1997) propose other techniques namely object-oriented technology and rapid applications development

The problem with technology currently in use is the fact that significant changes to technology are not easy to accomplish (Lucas and Olson, 1994). In relation to software in particular, Upton (1995b) argues that many companies have been misled by the 'soft' in software. Soft implies easily changeable or malleable. His experience shows that manufacturing-integration software is often anything but soft. In a later paper he argues that companies are still struggling to make their information systems more flexible (Upton and McAfee, 1996).

2.7.3 Discussion

IT can be the source of both flexibility and inflexibility. Lucas and Olson (1994) argue that information technology *can* make a major contribution to organisational flexibility. They do not claim that increased flexibility has been gained, or will be gained, by every organisation employing technology. They argue that two types of flexibility exist; organisational and technological. The difference between organisational and technological flexibility is one of paradox. Technology can contribute to organisational flexibility, but IT itself is often considered inflexible, because the technology that provides flexibility soon becomes old and hard to maintain, and the organisation tends to become more inflexible over time.

2.8 Conclusion

Flexibility is an important trait which organisations seek. The definition of flexibility is fraught with difficulties due to the fact that it has many dimensions. Specifically, for the purpose of this research flexibility is defined as having four dimensions; temporal, range, intention and focus. The **temporal** dimension is the time which it takes an organisation to react to change. The **range** dimension is the potential responses that the organisation possesses, first, to changes which were foreseen and, second, to those that were not foreseen. The **intention** dimension acknowledges that organisations can either be offensive or defensive in their approach to flexibility. In other words, while change is inevitable certain organisations manage it to their advantage and others do not. The final dimension of flexibility is **focus**, which can be both internal and external. The flexibility available to an organisation is not confined to within its organisational boundaries. It can use its external relationships with its trading partners to extend its flexibility.

The measurement of the four dimensions can be achieved only in a situation-specific context. The temporal dimension can be measured by ascertaining the levels of efficiency and responsiveness that have been achieved. The range can be measured in terms of the versatility and robustness that the system provides. Versatility measures the ability of the system to enable an organisation to adapt to changes which they foresaw happening. Robustness measures the capability of the system to adapt to changes which were not foreseen. Thus, the four measurements of flexibility - efficiency, responsiveness, versatility and robustness - measure the temporal and range dimensions of flexibility. The other two dimensions of flexibility, intention and focus, are defined within the context of the variable being studied.

Information technology can enable organisational flexibility. Specific components of information technology and information systems may enable an organisation to adapt faster. IT can provide increased flexibility by providing an

infrastructure which is constructed in such a way that changes can be made easily. As such, using the technologies provides organisations with flexibility that they would otherwise not have possessed.

Information technology may also reduce an organisation's flexibility. This occurs when the technology which is used to create the IS is not adaptable to changes. As such the technology being used can restrict flexibility, while its application can enhance organisational flexibility. This dual aspect of information technology implies that any IT system has to be assessed at two levels. The first is the extent to which it provides an organisation with flexibility and the second is the degree to which the specific technology being used is flexible and amenable to modification.

An additional avenue in which flexibility can be provided by IS is by deploying IOS. These systems provide organisations with the capability to create electronic connections with trading partners. They enable organisations to obtain more flexibility concurrently within the organisation and in their relationship with trading partners. This type of information system is reviewed in detail in the next chapter.

CHAPTER 3

Literature Review: Inter-organisational Systems

3.1 Introduction

Chapter 2 presented the dimensions and metrics of flexibility. It argued that these can only be operationalised with respect to a specific variable or subject. This chapter presents inter-organisational systems, the focus of this study. The chapter outlines the influence that information technology has on inter-organisational transactions and then provides a definition of IOS. From this definition the main technological components of IOS are outlined. The potential of these IT components to positively and negatively influence flexibility is presented.

The effects that IOS usage may have on organisations are then presented in terms of the four metrics of flexibility; efficiency, responsiveness, versatility and robustness. This research presents the first attempt to classify the effects of IOS in such a way. Using this classification of IOS effects enables flexibility with respect to IOS to be operationalised. Next, organisational factors which have been identified in organisations who achieve higher levels of benefits from IOS are discussed. This research postulates that as flexibility is a benefit of IOS, these organisational factors may also influence the level of flexibility that organisations achieve from these information systems.

3.2 Effect of Information Technology on Interorganisational Transactions

The use of paper to complete commercial transactions dates back at least as far as the middle ages. Weatherford (1997) shows that 'bills of exchange' were in use within Europe during the fourteenth century. As information technology emerged it has been continually used to aid commerce. The use of information technology to enable the completion of interorganisational transactions is not a new phenomenon. Bakos (1988), proposes that the mail service and telephone networks can be considered as long-standing examples of the use of IT to support interorganisational transactions. In a later article, (Bakos, 1991a) he further argues that these systems have become indispensable because interorganisational transactions play a central role in our economic system.

The advent of computers and computer networks broadened the definition of IT beyond the mail service and telephony. Leavitt and Whisler (1958) predict that the new forms of information technology will radically change the way organisations work. This assessment of IT's impact is extended to interorganisational transactions by Kaufman in 1966. He predicts that data systems that cross organisational boundaries will become a reality and that progressive management need to plan for them.

> 'We are now witnessing the prospective developments of systems broad enough to cut across company boundaries. Obviously, such systems can have a profound impact on the way business and commerce are conducted' (Kaufman, 1966, p. 141).

In 1971 Stern and Craig reiterate Kaufman's prediction and propose that the ability of a computer to exchange and disseminate information will take on increased importance, particularly between organisations. By the early 1980's research into the application and use of IT to support interorganisational

transactions emerged (Barrett and Konsynski, 1982; McFarlan, 1984; Cash and Konsynski, 1985, Runge, 1985; Cash, 1985). The reason for the increased use of such systems was due to the technical quality and capability of information systems technology which has made the widespread use of such systems possible (Cash and Konsynski, 1985).

3.3 Definition of Inter-organisational systems

The first definition of IT systems that cross organisational boundaries is provided by Stern and Craig (1971) who call such systems *Interorganisational Data Systems*. They define such systems as computer-based communications systems directly linking two or more firms for the purpose of information exchange. The next attempt to define IT-based inter-organisational systems occurs in the early 1980's during which a plethora of definitions were proposed (Suomi, 1992).

The term 'inter-organisational system' now has several versions in the literature (Suomi, 1992). Barrett and Konsynski (1982) call such systems inter-organisational sharing systems, which they abbreviate to 'IS*'. Subsequently the acronym IOS came to represent such systems. However the words to be included in the extrapolation of the acronym differ. Some authors explicitly include the word 'information', while others do not include it but rather assume that the inter-organisational system exchanges information (Figure 3.1).

Explanation of 'IOS'	**References**
Inter-Organisational Systems	Cash (1985), Grover and Teng (1994)
Inter-Organisational Information Systems	Bakos (1987), Johnston and Vitale (1988), Sheombar, (1992), Fredriksson and Vilgon, (1996)

Figure 3.1: Explanation of IOS Acronym

Other acronyms are suggested for IT systems that cross organisational boundaries, such as EOS - extra organisational systems (Lu and Song, 1987) and IOIS - inter organisational information system (Choudhury, 1997). While different abbreviations have been proposed all have common criteria when it comes to defining what constitutes an inter-organisational system based on IT. The main components of such systems are presented in the next paragraph. For the purpose of this research the acronym IOS is defined as Inter-Organisational Systems.

The majority of the definitions of IOS cite three essential ingredients (Figure 3.2);

1. crosses organisational boundaries
2. based on IT
3. facilitates the exchange of information electronically between computer systems.

Properties of IOS	References
Cross organisational boundaries,	Barrett (1986), Bakos (1988, 1991a, 1991b), Holland et al. (1992), Suomi (1994)
Systems based on IT	Cash and Konsynski (1985), Barrett (1986), Bakos (1988), Holland (1992), Suomi (1994)
Exchange of information electronically	Barrett and Konsynski (1982), Cash (1985), Cash and Konsynski (1985), Barrett (1986), Edwards (1987), McNurlin (1987), Bakos (1988), Hansen and Hill (1989), Holland et al. (1992), Mackay (1993), Cunningham and Tynan (1993), Clarke and Jenkins (1993)

Figure 3.2: Properties of IOS

The first property of IOS is that they cross organisational boundaries; more than one organisation is involved in the system (Bakos, 1987). This represents an important qualitative difference from intra-organisational systems. Identifying appropriate organisational boundaries between the participants of IOS is often a difficult and ambiguous task. Kumar and van Dissel, (1996) define the

boundaries in terms of legal enterprise boundaries, while Suomi (1994) defines them as occurring between two or more independently managed organisations.

One of the reasons for the difficulty in operationalising organisational boundaries is because subsidiaries of large organisations often trade with each other using information technology. The question arises whether such systems should be classified as inter-organisational or intra-organisational. Bakos (1991a) in addressing this issue considers two organisations separate if they are distinct economic agents. This condition typically requires separation of authority in primary budgetary and policy matters. For the purpose of this research this definition of organisational boundaries is adopted.

The second property of IOS is that they are based on IT. Computers and computer networks are the key IT components (Kaufman, 1966). Johnston and Vitale (1988) define information technology as comprising of computer and communication technology that facilitates the creation, storage, transformation and transmission of information. Presenting a similar definition of IT, Kumar and van Dissel (1996) referring to previous research (Bakos, 1991b; Chismar and Meier, 1992; Konsynski, 1993) define IOS as being information and communication technology-based systems that transcend legal enterprise boundaries.

The third property of IOS is the exchange of information electronically. Cash and Konsynski's (1985) define this using the words 'an automated information system', a definition that was adopted subsequently by Johnston and Vitale (1988) and Chismar and Meier (1992) among others. Suomi (1994) provides a more strict definition of this property when he states that IOS are systems in which two or more independently managed organisations communicate in a computer memory to memory fashion, without the transfer of physical media. Under this definition IOS must possess the facility to transfer information across telecommunications channels and therefore the transfer of physical media such as disks are excluded.

In combining the three main properties of IOS the following definition is adopted for the purpose of this research:

> a computer based information system that facilitates the exchange of information electronically using telecommunications between different organisations' computer systems.

3.4 Types of IOS

The broad definition of IOS adopted for this research means that many forms or types of IOS qualify. Suomi (1994) argues that within the definition of IOS there are three principle types of systems: (1) electronic data interchange, or the transfer of computer files or transactions from one computer to another, either in batch or on-line mode; (2) electronic mail, or the transfer of human-initiated messages from one computer to another; and (3) the human usage of external databases with computer interfaces. For the purpose of this research this framework of IOS types is adopted.

The first type of IOS identified by Suomi (1994) are electronic data interchange (EDI) systems. A large portion of research on IOS has focused on this particular type of IOS. In general, definitions of EDI are more restrictive than definitions of IOS as they have additional requirements such as agreed standards (Hansen and Hill, 1989) and direct computer to computer integration without human intervention (McNurlin, 1987). In this research EDI is treated as a subset of IOS as has been proposed elsewhere (McNurlin, 1987, Senn, 1992; Swatman and Swatman, 1992; Holland et al., 1992; Scala and McGrath, 1993; Van Over and Kavan, 1993; Premkumar et al., 1994; Choudhury, 1997). The next section discusses the technology used in IOS. The ways in which the technology has a positive and negative impact on flexibility are outlined.

3.5 IOS Technology

Inter-organisational systems, by definition, require the use of computers and telecommunications. The main technologies required for IOS are first, a telecommunications method which provides the means for transmitting the messages, second, messaging standards which facilitate communication, and third, software whose purpose is to act as a translator, converting and understanding messages which have been sent in agreed formats.

3.5.1 Telecommunications Method

An essential part of any IOS is the telecommunication method which allows messages to be exchanged between trading partners (Hill, 1991). There are three main forms of telecommunications used in IOS; proprietary networks, telephone lines and value added network services (VANS). Proprietary networks are normally used within organisations and between trading partners who have very close working relationships. Telephone lines may be used in conjunction with a modem to facilitate direct computer to computer exchange of messages. For most organisations however, an intermediary VANS is used. VANS provide electronic mailbox facilities for organisations which allows the storage of IOS messages. This facility saves organisations the need of having a permanent open telecommunications line.

VANS are seen as an important technology that will increase the growth rates of IOS (Emmelhainz, 1988). In addition, it is argued that the use of VANS provides 'flexibility' as it facilitates the easier adding and deleting of trading partners (Hansen and Hill, 1989). The use of such VANS effectively outsources telecommunications problems and should enable connectivity with any trading partner with relative ease.

However, different VANS exist and trying to exchange messages between them has proved problematic due to incompatibility problems (Fynes and Ennis, 1993). The extent of these incompatibilities leads Janssens and Cuyvers (1991) to state that it is highly improbable that one single VANS can serve the needs of a multinational, multi-market company. Other criticisms are directed at VANS, namely that they have frequently been found to be imposing, non-supportive, and costly (Massetti and Zmud, 1996).

In summary, VANS have been proposed as a technology which aids flexibility by enabling firms to add and delete trading partners easily. However, the existence of different VANS which are not always compatible may reduce the flexibility of organisations by forcing them to subscribe to more than one VANS in order to communicate with different trading partners.

3.5.2 Messaging Standards

Messaging standards form a vital component of IOS, and in particular of EDI, a subset of IOS. Agreeing the specific messaging standard to be used between two organisations enables them to communicate via computer to computer integration without human intervention. The purpose of such messaging standards is to facilitate the automatic transfer of data.

However, different messaging standards exist and the proliferation of these competing standards has bedevilled the development and widespread application of EDI services (Edwards, 1987). Currently two major EDI standards exist - ANSI X12 predominates in the US and EDIFACT which is used in Europe (Janssens and Cuyvers, 1991). However additional standards exist for different industrial sectors, such as ODETTE for the car manufacturing industry and TRADACOMS for the UK retail industry. It is unlikely that an overall global messaging standard will emerge in the near future because companies, which

already have operational systems based on other standards, see no immediate reason to change their systems (Janssens and Cuyvers, 1991; Picot et al., 1993).

Further complications are caused due to the fact that systems based on 'standards' are not standard (Cavaye, 1995). The reason for this is that organisations develop variations on agreed document translation standards in order to enable communication with the information systems of different trading partners (Swatman and Swatman, 1991). A second reason as to why organisations do not implement a complete messaging standard is due to the fact that it is possible to implement more manageable subsets. This practice is particularly prevalent in situations where organisations enforce a subset on trading partners who will comply as the cost of keeping a wider more complete standard is prohibitive. The adoption of such variations and subsets of messaging standards '*reduces the flexibility* to a very large extent' (Horluck, 1994). Indeed, Reekers (1994) argues that the variety of standards poses a major obstacle preventing the achievement of higher level strategic benefits from IOS.

Extending the number of messages that existing IOS can communicate can be problematic. Janssens and Cuyvers (1991) propose that a standard like EDIFACT needs years before acceptance occurs because only a small number of internationally accepted messages already exist. Massetti and Zmud (1996) make a similar point proposing that organisations striving to expand the range of their EDI document base must adapt to a variety of document exchange formats, including different messaging standards.

One of the key assumptions behind the idea of messaging standards is the capability to operate within *'foreseen'* domains (Brousseau, 1994). This key assumption is questioned by Galliers et al. (1995) who propose that the management perspectives on EDI are too often based on a single set of assumptions about the way in which business will be conducted in the *'foreseeable'* future. EDI, then, is often considered in isolation both from other technological innovations and from changes in business practice (Swatman and

Swatman, 1991). However, many authors argue that in order to gain lasting benefits from IOS it is necessary to redesign the business or network process (Sheombar, 1992; Caderet, 1992; Venkatraman, 1994), something which is not possible if IOS seek only to automate existing processes (Galliers et al., 1995). From the view point of flexibility, these arguments indicate that messaging standards fail to take account of unforeseen circumstances and therefore lack robustness.

In summary, messaging standards are a necessary part of IOS, without them communication could not take place. However, different standards exist, and within agreed standards variations are possible. As a result of conforming to a variety of document standards, an organisation may find itself electronically exchanging numerous documents, representative of the same value-chain flows but unable to integrate these flows in an electronic manner, internally or externally (Clarke, 1992). In this way various messaging standards can reduce the flexibility of an organisation because changing IOS requires the amendment of more than one messaging standard in the system. The premise on which messaging standards are developed is a foreseeable future. Thus, messaging standards do not provide flexibility in the form of robustness, the ability to adapt to unforeseen circumstances.

3.5.3 Software

Each of the trading partners requires software to be able to use IOS. The software enables each firm to translate the message into the correct format to facilitate its transmission over the telecommunications lines. The software also acts as the interface to translate and understand incoming messages received via IOS. If the organisation is using a VANS then the software is normally provided as part of the service. Other options concerning the procurement of the software involve buying it off-the-shelf or creating it in-house.

3.6 Reasons for Adopting IOS

In chapter two, one of the four dimensions of flexibility outlined was intention. This was defined as the extent to which an organisation seeks flexibility either offensively or defensively. It was argued that intention was a situational dimension in that measurement is only possible when a specific variable or subject has been identified. For the purpose of this research that subject is IOS and this section presents a review of the reasons why organisations adopt IOS. Some adopt such systems offensively and others defensively.

Initially, IOS were seen as strategic systems which could provide a competitive advantage to the organisation who initiated them (Barrett and Konsynski, 1982, McFarlan, 1984; Porter and Millar, 1985; Barrett, 1986, Wrigley et al., 1994). The strategic importance of IOS is shown by Emmelhainz (1988) who, in a study of fifteen organisations, finds that all adopted EDI to gain a competitive advantage.

This competitive advantage is believed to be achievable by creating switching costs (Bakos and Treacy, 1986) which 'locks -in' (Feeny 1986) customers. The prominence of such beliefs is illustrated by an article in Fortune (1985) titled 'How to keep customers happy captives'. Other strategic reasons for adopting IOS include the potential to increase market share (Clemons and Kleindorfer, 1992) and to enable time based competition (Holland et al., 1992).

The extent of the belief in the importance of IOS meant that such systems went from being a competitive weapon, to a necessary way of doing business (Bakos, 1988; Rochester, 1989; Benjamin et al., 1990). Initially, IOS were adopted by organisations because of the strategic potential of being an early adopter. Within a short period, however, organisations were adopting it in order to prevent themselves being at a competitive disadvantage.

In any discussion about the reasons for adopting IOS it is important to remember that such systems, by definition, cross organisational boundaries. As such these systems involve two or more firms. The organisations using IOS do not always have similar reasons for adopting the same system. This is particularly true in situations where the system has not been developed collaboratively.

Feeny (1988) argues that the provider cannot demand or instruct a user to accept the system, instead they can only persuade. However, pressure from trading partners who are IOS initiators plays a critical role in IOS adoption, particularly by smaller firms (Swatman and Swatman, 1991; Webster, 1994). The 'persuasion' by large companies on small supplier companies usually takes the form of, 'an offer you can't refuse' (Palmer, 1988). The offer is presented in terms of the 'desourcing' or 'delisting' argument made famous by the US automotive manufacturers - 'do business with EDI or don't do business with us' (Galliers et al., 1995). In some instances, coercion of smaller suppliers to move to EDI is used by large manufacturers in order to suit the information technology and business strategies of the manufacturers (Webster, 1995). In effect, some organisations have no choice but to adopt IOS (Cunningham and Tynan, 1993). In one study Mackay (1993) finds that 67% of companies adopted EDI because they were told to.

Thus, the reasons for adopting IOS can differ between the participants of the one system. For the most part organisations who initiate IOS have different reasons for adopting such systems than the trading partners with whom they trade using IOS. The initiators adopt the system for strategic reasons. The non-initiating trading partners, however, start to use IOS for defensive reasons. In this way the initiating organisations are offensive users of IOS in the sense that they proactively start to use the system, while the non-initiating firms are reactive users because they adopt IOS on the request of trading partners. Ascertaining whether or not an organisation initiated IOS enables an organisation to be classified as an offensive or defensive user of IOS. Using this classification, it is

possible to locate organisations on the intention dimension of flexibility outlined in Chapter 2.

3.7 Effects of IOS

This section presents a review of the effects that IOS have on organisations. In conducting this review the effects were categorised on the basis of the four measurements of flexibility; efficiency, responsiveness, versatility and robustness, outlined in Chapter 2. By completing such a classification, this section specifically operationalises the four metrics of flexibility in terms of IOS. This enables the measurement of the temporal and range dimensions of flexibility (outlined in chapter 2) for IOS.

3.7.1 Effects of IOS on Efficiency

IOS effects on efficiency in terms of improving the buying process, decreasing costs, increasing productivity and enabling better cash management has been highlighted in the literature (Figure 3.3). The areas of efficiency are discussed individually in the remainder of this section.

3.7.1.1 Improvements in the Buying Process

Improvements in the buying process due to the use of IOS are brought about in several ways. First, the adoption enables the organisations connected via IOS to improve their inventory management. This is particularly true for the buyer, due to the fact that the speedier IOS link allows them to order more frequently and, thus, reduce the amount of inventory they hold. In IOS which are based on partnership the buyer may share their production schedules and forecasts with suppliers. This enables the supplying firm to more accurately anticipate demand

and allows them to reduce the level of buffer stock that they hold for unanticipated orders.

Categorisation of Effect	References	Effect
Improved Buying Process	Janssens and Cuyvers (1991), Hill (1991), Bakos (1991a), Mukhopadhyay et al. (1995)	Inventory management improves
	Hansen and Hill (1989), Bakos (1991a)	Fewer out-of-stock situations
	Hill (1991)	Flexible buying strategy
Decreased Inventory Costs	Hansen and Hill (1989), Scala and McGrath (1993), Suomi (1994), Fredriksson and Vilgon (1996),	Lower inventory costs
Decreased Administration Costs	Tracy (1991), Hill (1991), Scala and McGrath (1993) Barrett and Konsynski (1982), Johnston and Vitale (1988), Riggins et al. (1994), Cavaye (1995), et al. (1995), Bakos (1991)	Administrative cost savings reduces data re-entry Lower transaction costs Reduces document transmission costs Reduces cost of co-ordination
Decreased Labour Costs	Hansen and Hill (1989), Scala and McGrath (1993)	Cost savings: Labour
Increased Productivity / Efficiency	Kavan and Van Over (1990), Mackay (1993), Scala and McGrath (1993), Barrett and Konsynski (1982)	Improves productivity
	Venkatraman and Zaheer (1994), Riggins et al. (1994)	Greater efficiency
	Stern and Kaufmann (1985), Hansen and Hill (1989), Bakos (1991), Carter and Ragatz (1991), Mackay (1993), Scala and McGrath (1993) Riggins and Mukhopadhyay(1994)	Increases data accuracy Improves data integrity
	Janssens and Cuyvers (1991), Hill (1991)	Better control of transport and distribution
Better Cash Management	Kavan and Van Over (1990), Van Over and Kavan (1993)	Reduces financial exposure
	Janssens and Cuyvers (1991), Hill (1991), Scala and McGrath (1993)	Better cash management, improves cash flow

Figure 3.3: Efficiency effects of IOS

The second improvement in the buying process occurs because buying organisations can reduce the occurrence of stock-outs. This is seen as being particularly important in the grocery sector where an out-of-stock item frequently means a lost sale. IOS allow the buyer to order more regularly from the supplier and, if fully automated internally, the system may automatically generate purchase orders to prevent out-of-stock situations.

The third improvement in the buying process is that IOS enable more flexible buying strategies (Hill, 1991). The specific areas where flexibility is enhanced are (1) quick notification of out-of-stock items gives a better opportunity to take alternative action, (2) quick response to a request for quotation enables more competitive buying and (3) improves the connection to overseas supply sources.

3.7.1.2 Cost Savings

The second area in which IOS improves efficiency is in the area of costs. Tracy (1991) gives quantified statistics of the cost savings achievable from using EDI. Specifically he states that the retail industry estimates that up to 0.3% of sales can be added to profit, the US auto industry estimates that cost savings of as much as $200 per auto are possible and General Electric Transportation Services estimate that their EDI program adds approximately 0.5% to Return on Sales.

The specific areas where IOS reduce the costs associated with inter-organisational transactions are in the domains of inventory management, administration and labour. Inventory costs are lowered due to the fact that IOS enable customer organisations to keep lower levels of stock due to the ability to reorder quicker. Supplier organisations reduce their inventory costs due to their ability to more accurately forecast sales due to more accurate forecasts.

Cost savings occur in administration due to the fact that the electronic transfer of data eliminates the need to key in data. In addition, savings occur since sending documents electronically is cheaper than via conventional means. Kavan and Van Over (1990), provide figures for the magnitude of the cost savings. A manually prepared document costs $49 to create and transfer, while the figure for a corresponding EDI transaction is only $4.70. Labour costs are also reduced since jobs which were required to enter data into the system are no longer needed due to the electronic transfer of the data.

3.7.1.3 Efficiency and Productivity Gains

IOS improve the efficiency and productivity of inter-organisational processes. Specifically they provide improvements in the accuracy and integrity of the data and enable organisations to exert better control over the transport and distribution of goods. Data accuracy is increased due to a reduction in re-keying and clerical errors (Reekers and Smithson, 1994). This results in efficiency gains due to less documentation rework and electronic document error reconciliation (Riggins et al., 1994). The increased accuracy of the data improves the integrity of the data stored in the system.

IOS provide improvements in the control over the transport and distribution of goods (Hill, 1991). These benefits accrue due to the ability of IOS to enable (1) a more predictable time for the receipt of goods, (2) direct instead of centralised distribution of goods, (3) reduced transport costs due to improved consolidation, (4) shorter customs processing times.

3.7.1.4 Better Cash Management

The use of IOS enables organisations to reduce their financial exposure (Kavan and Van Over, 1990) while at the same time improving cash flow (Janssens and

Cuyvers, 1991). The reduced financial exposure is due to the fact that IOS can help contain commercial risk. This is achieved because IOS enable closer working relationships between trading partners and a few key suppliers. This reliance on a smaller number of more familiar suppliers lowers the commercial risk (Kavan and Van Over, 1990). Cash management is improved because IOS can enable precise control over the timing of payments, better credit control and less money in the trading cycle (Hill, 1991).

3.7.2 Effect of IOS on Responsiveness

The preceding section discussed how IOS improve effectiveness. In this section the impact of IOS on responsiveness is addressed. IOS improve responsiveness by enabling organisations to react more quickly. Specifically, IOS improve responsiveness by reducing time delays, by increasing customer service levels, by enabling better trading relations and by making information available more quickly (Figure 3.4).

3.7.2.1 Reduction in Time Delays

The use of IOS helps reduce time delays particularly due to the ability to transmit data over large geographic distances in minutes. The effect of removing the 'information float time' is the element that appears to cause the most changes in company procedures (McNurlin, 1987). Hill (1991) calls this effect of IOS the 'removal of the dead data time period'. With IOS, data is available practically the moment it is sent. The removal of paper documents means that no time is wasted in storing, forwarding and delivering documents.

The increases in the speed of transmission have resulted in faster trading cycles (Fynes and Ennis, 1993), which serve to compress the business cycle (Senn, 1992). These manifest themselves in the form of reduced order lead times

(Hansen and Hill, 1989). The adoption of IOS enables organisations to enter the era of time based competition (Stalk, 1992), where the ability to respond to customer requests becomes paramount (Holland et al., 1992). One area in which time plays a central role is in just-in-time (JIT) inventory management. Srinivasan et al. (1994), in a study of JIT practices finds that the adoption of EDI is instrumental in enhancing performance.

Categorisa-tion of Effect	**References**	**Effect**
Reduction in Time Delays	Stern and Kaufmann (1985), Bakos (1991a), Scala and McGrath (1993), Suomi (1994), Cash and Konsynski (1985) Riggins et al. (1994), Cavaye (1995), Fredriksson and Vilgon (1996),	Speeds the transmission of information Fast, reliable information exchange
	Hansen and Hill (1989), Jelassi and Figon (1994)	Reduces order lead times
	Carter and Ragatz (1991), Holland et al (1992), Hansen and Hill (1989), McNurlin (1987), Bakos (1991), Konsynski (1992),	Elimination of information float time
Better Trade Relations	Hansen and Hill (1989), Hill (1991), Mackay (1993), Scala and McGrath (1993) Johnston and Vitale (1988)	Improves communications Improves trade relations Tighter links to customers
	Hansen and Hill (1989), Janssens and Cuyvers (1991), Mackay (1993), Fynes and Ennis (1993), Van Over and Kavan (1993), Jelassi and Figon (1994)	Improves customer service
Availability of information	Stern and Kaufmann (1985), Klein (1992)	Enhances intelligence and statistical reporting

Figure 3.4: IOS Effects on Responsiveness

3.7.2.2 Better Relationships with Trading Partners

In addition to reducing time, IOS can also help foster better relationships with trading partners. This occurs because IOS increase bandwidth (Bakos, 1991), which allows improved data sharing (Reekers and Smithson, 1994). One example of this increased data from marketing channels would be the sharing of data on promotions, price changes and product availability (Stern and Kaufman, 1985). The sharing of information on projected demand has enormous opportunities for improved timeliness (Mukhopadhyay et al., 1995) and increased flexibility (Bakos and Brynjolfsson, 1993a). The use of IOS to share information enables organisations to be more responsive because of the fact that they are receiving the additional information faster.

IOS also improve customer service levels, particularly in that trading partners using IOS are seen to be more responsive to customer requests. The improved customer service levels can be seen in areas such as improved vendor relationships and improved customer loyalty (Reekers and Smithson, 1994). The use of IOS facilitate closer links with other trading partners and these are often perceived as improvements in customer service.

3.7.2.3 Availability of Information

The ability to transmit data faster means that it is available for use sooner. The effect that EDI has on efficient logistics of information is very important (Klein, 1992). Such information availability provides the opportunity for enhanced intelligence and statistical reporting in which trends can be monitored and responded to more quickly. The availability of such information can be used to enhance a company's marketing effort (Scala and McGrath, 1993).

In summary, IOS can improve the responsiveness of organisations. This increased responsiveness comes in the form of speedier exchange of data and faster cycle times. In addition, increased levels of organisational responsiveness

underlie the improvements in trading relationships and improved customer service. Finally, the speedier receipt of information enables organisations to respond more quickly to changes in the marketplace.

3.7.3 Effects of IOS on Versatility

The concept of versatility as defined in Chapter 2 is the range of options that an organisation has open to it to react to foreseen changes. In this sense versatility is flexibility which an organisation has created by active planning. Given this definition, IOS has three effects on versatility. These are increased product differentiation, increased business and increased outsourcing (Figure 3.5).

Categorisation of Effect	References	Effect
Increased Product Differentiation	Feeny, (1986), Johnston and Vitale (1988)	Increased product differentiation
Increased Business	Emmelhainz, (1988), Clemons and Kleindorfer, (1992), Scala and McGrath (1993), Reekers and Smithson, (1994), Venkatraman and Zaheer (1994), Wang and Seidmann, (1995)	Increased business
Increased Outsourcing	Klein (1992), Picot et al. (1993), Bahrami and Evans, (1995)	Focus on core competencies

Figure 3.5: IOS Effects on Versatility

3.7.3.1 Increased Product Differentiation

The use of IOS enables organisations to differentiate their product from their competitors. Initially, such differentiation arose by virtue of being able to conduct business electronically. However, with the widespread adoption of IOS this is no longer the case. Instead, organisations are exploiting IOS technology to

create differences. The use of IT enables organisations to handle a greater diversity of products. In addition, IOS enable organisations to create differences in the total product offering in areas such as delivery times, lead times and levels of responsiveness. By creating such product differentiation, organisations increase their versatility. This is achieved by increased product differentiation providing organisations with a wider range of products and services to offer customers.

3.7.3.2 Increased Business

The second avenue through which IOS increase versatility is by facilitating increased business, specifically to new customers. This is possible because once the organisation possesses IOS it can trade with additional customers using the system. This ability to trade electronically is something which can be marketed and used as a product enhancement to gain new business. The attainment of new customer accounts increases the versatility of the business as it reduces the dependence on any one customer.

3.7.3.3 Outsourcing

The third avenue by which IOS can increase versatility is by facilitating outsourcing. By doing this IOS enable an organisation to focus its resources on strategically important core activities (Klein, 1992; Picot et al., 1993). The benefit of outsourcing is that it off loads some of the risk to suppliers (Piore and Sable, 1984). Versatility is increased by outsourcing because it enables organisations to have access to more sub-components from which to make the final product. In this way the organisation can carry less stock and adjust to market demands more quickly.

3.7.4 Effect of IOS on Robustness

The fourth classification of IOS effects is robustness. As defined in Chapter 2, robustness is the ability of the organisation to react to unforeseen circumstances. It is about building flexibility into the process so that it is adaptable in the future to requirements that were not planned for. In this regard IOS facilitates robustness in two main areas, the move to preferred supplier lists and the restructuring of the value chain (Figure 3.6).

Categorisation of Effect	References	Effect
Preferred Suppliers	Emmelhainz (1987), Cunningham and Tynan (1993), Venkatraman and Zaheer (1994), Wang and Seidmann (1995)	Reduction of the vendor base
Restructure the Value Chain	Bjorn-Andersen and Krcmar (1995), Oswald and Boulton (1995)	Eliminate stages of the value chain

Figure 3.6: IOS Effects on Robustness

3.7.4.1 Preferred Suppliers

The movement towards a preferred supplier list is believed to be good for business and is enhanced by IOS (Emmelhainz, 1987). More recently such initiatives are classified as a 'rationalisation of the supply chain' (Cunningham and Tynan, 1993). The reason for such initiatives is a recognition that purchasing can contribute to competitive strategy in much the same way as marketing. Evidence of the existence of the trend is provided by Bjorn-Andersen and Krcmar (1995) who, in reviewing 14 case studies of EDI in Europe, find that almost all cases show a change towards a preferred supplier or trading partner. The movement towards preferred suppliers aids the creation of partnership type links which enables the trading partners to share more information (Johnston and

Lawrence, 1988). In so doing they increase their robustness by being able to adapt cohesively more quickly to changes in the marketplace.

Some have argued that the movement towards preferred suppliers reduces an organisation's ability to manoeuvre. Specifically it may cause a shift in the relative bargaining powers of trading partners, with the supplier gaining due to the buyer's greater dependence on fewer suppliers (Venkatraman and Zaheer, 1994). However, Wang and Seidmann (1995) disagree with this argument as their research shows that a supplier's adoption of EDI can generate positive benefits for the buyer.

In summary, IOS aid a movement towards preferred supplier listings. The effect of this on the degree of manoeuvrability of an organisation is currently unclear. Some argue that it increases robustness by facilitating closer partnership-like relationships, while others propose that IOS serve to 'lock-in' relationships which reduces the robustness of the organisation.

3.7.4.2 Restructuring the Value Chain

A potential exists also for IOS to enable the streamlining of the value chain. In particular large scale inter-organisational integration will eventually change the economics of doing business as it opens increased possibilities of shortcutting the process by eliminating some of the partners in the distribution channel (Bjorn-Andersen and Krcmar, 1995). Hence, IOS provide possibilities to reduce the number of steps involved in a value chain. This reduction enables robustness, as the shorter value chain requires less co-ordination and can collectively react to change better.

The adoption of IOS may however make the value chain more robust to the detriment of existing participants. Johnston and Vitale (1988) propose that one potential disadvantage of establishing IOS is the possibility that by establishing

IOS as an important basis for competition one may open the industry to entry by completely new players who will leverage their information systems skills. In this way IOS may facilitate and encourage major changes in the value chain.

3.8 Operationalisation of Flexibility for IOS

This section operationalises the metrics with respect to IOS. In doing this it uses the effects of IOS presented in the previous section. In addition, for each metric of flexibility additional operationalisation is provided from the literature on flexibility in chapter 2. In amalgamating the two sets of literature it is found that combined previous research on IOS adequately addresses the efficiency and responsiveness metrics of flexibility (Figure 3.7). The remaining two metrics, versatility and robustness are not addressed in detail in IOS research and a heavier reliance on the flexibility literature is required to operationalise these measurements.

Efficiency		
IOS Literature	**Operationalisation**	**Focus**
Buying process	• out-of-stock occurrences • flexible buying strategy	External Internal
Inventory costs	• inventory costs	Internal
Administration costs	• data re-entry costs • document transmission costs	Internal External
Labour costs	• labour costs	Internal
Productivity / Efficiency	• accuracy of data being received electronically • control over transport and distribution	External External
Cash management	• financial exposure • cash-flow	External Internal
Flexibility Literature	**Operationalisation**	**Focus**
Accommodate change	• ability to adapt to changing requirements	Internal
Internal information	• quality of internal information resources	Internal

(Figure 3.7 Continued on next page)

Responsiveness		
IOS Literature	**Operationalisation**	**Focus**
Time delays	• transmission of documents within organisation • lead time between trading partners	Internal External
Customer service	• customer service levels • responsiveness to the market	External Internal
Trade relationships	• improved communications with trading partners • tighter links with trading partners	External External
Information for decisions	• intelligence and statistical reporting for decision making	Internal
Flexibility Literature	**Operationalisation**	**Focus**
Responsiveness	• organisational responsiveness to the market	Internal
Versatility		
IOS Literature	**Operationalisation**	**Focus**
Product differentiation	• offer a wider product range	Internal
Increased business	• overall performance of the organisation	Internal
Outsourcing	• amount outsourced to trading partners	External
Flexibility Literature	**Operationalisation**	**Focus**
Adaptable	• adapt more easily to changes	Internal
Range of activities	• diversify into new markets	External
Robustness		
IOS Literature	**Operationalisation**	**Focus**
Preferred suppliers	• total number of trading partners	External
Restructure the value chain	• need for intermediary organisations • faster business cycle along entire value chain	External External
Telecommunications	• expand trading network	External
Flexibility Literature	**Operationalisation**	**Focus**
Uncertainty	• reposition organisation in the marketplace • change strategy of the organisation	Internal Internal
Capacity for new situations	• competitive advantage	Internal
Unforeseen change	• react to unforeseen circumstances	Internal

Figure 3.7: Operationalisation of Flexibility for IOS

IOS by definition cross organisational boundaries. Therefore the effects such systems will have on an organisation will be both internal and external. Each of the identified effects of IOS was positioned on the basis of whether its impact is received within the organisation or by the organisation to whom it is connected via IOS (Figure 3.7). In identifying this difference it is possible to get a measure of how much IOS facilitate external and internal flexibility, which is one of the dimensions of flexibility.

3.9 Enabling Organisational Factors

Organisations differ in the degree to which they achieve the possible positive effects which have been proposed for IOS. This section presents variables which have been found in previous research to affect the level of benefits achieved from IOS. It is proposed that some of the variables which have an influence on the level of benefits obtained from IOS may also affect the degree of flexibility which organisations achieve from IOS (Figure 3.8).

Enabling Organisational Factors
Organisational Size
IOS Initiator
Offensive adoption of IOS
Integration of IOS plan with IS plan
Integration of IOS plan with business plan
Level of IT expertise existing within the organisation
Integration of IOS software with other internal IS
Competitive environment
Longevity of IOS use
Industry Sector

Figure 3.8: Organisational factors enabling higher levels of flexibility

3.9.1 Organisational Size

Sabherwal and Vijayasarathy (1994) find that the size of organisations influences the degree to which IOS are used, with medium sized companies making less use of IOS than larger companies. One reason for this may be that IOS often operate to the greater advantage of large organisations relative to smaller ones due to the power that organisational size provides (Webster, 1995). Clarke (1992) argues that electronic trading networks crystallise the power imbalance between the large and small organisations and enable the large organisations to extract most of the benefits from IOS. Borman, (1994) on the other hand, proposes that small businesses have an advantage in that they are not constrained by existing processes and, as such, may reengineer processes in order to obtain increased levels of benefits.

3.9.2 IOS Initiators and Non-Initiators

Important distinctions exist between the users of IOS and the providers of the system (Chismar and Meier, 1992). In the past, initiators of IOS were suppliers seeking to add value to their product and gain a competitive advantage over their rivals by providing better service and cost saving to their customers (Riggins et al., 1995). Two case studies which outline these efforts by suppliers are American Hospital Supply Corporation (Konsynski and McFarlan, 1990) and McKesson (Clemons and Row, 1988). However, recent trends in the usage of IOS indicate that dominant buyers in several industries, particularly in the automotive, aerospace, and retailing industries, act as initiators of these networks to their suppliers (Sokol, 1991).

For organisations who initiate IOS changes occur in the areas of strategy and organisation structure first, training and selection of employees second, and business process third (Cash and Konsynski, 1985). However, for non-initiators the order is reversed (Cash, 1985). The order in which impacts occur has

important implications for the degree to which each organisation benefits from IOS. Initiating organisations tend to integrate IOS into their internal systems, and by so doing obtain strategic benefits (Swatman and Swatman, 1992).

O'Callaghan et al. (1992) believe that typically EDI systems are designed to deliver benefits to both the initiating and non-initiating firms. However these benefits are not always shared equally. Stern and Kaufmann (1985) find that the majority of EDI users they surveyed believe that their trading partner benefits more from the system than themselves. Benjamin et al. (1990) find that the initiator of the system gains more immediate and measurable benefits from IOS. Wang and Seidmann (1995), argue that the benefits are unevenly dispersed, and in their research find that the initiating buyer organisations may be the only ones who gain from EDI.

Some reasons have been offered as to why non-initiators do not gain the same level of benefits as initiators. Swatman and Swatman, (1991) argue that while non-initiators can obtain benefits, they frequently fail to do so because of their inability to take a top-down strategic view which would incorporate IOS. Mackay (1993) finds that non-initiators who are coerced into adopting IOS receive higher levels of benefits when they integrate IOS into existing IS systems.

3.9.3 Initial reason for adopting IOS

The initial reason that an organisation adopts IOS may influence the subsequent effects that IOS have. Organisations who adopt IOS with positive, offensive reasons tend to obtain higher levels of benefits than those who adopt defensively. The initial reason for adoption differs from the initiator/non-initiator aspect in the fact that it is possible for a non-initiator to adopt IOS offensively. As such the non-initiator having been requested to adopt IOS makes such an adoption part of its organisational strategy and proactively manages the adoption. Swatman et al. (1994) find that organisations which take a proactive view of IT are those most

likely to benefit from the opportunity for reengineering offered by IOS. On the other hand organisations who adopt IOS due to a trading partner mandate tend not to accept or widely use the system (Hwang, 1991).

Hence, those organisations who adopt IOS offensively and proactively have been found to obtain higher levels of benefits than those who do so defensively and reactively. In a similar way it may be that the offensive adoption of IOS brings higher levels of flexibility relative to those who adopt the technology defensively.

3.9.4 Integration of IOS plan with IS plan

Jackson (1988) argues that the full benefits of EDI only accrue if EDI is viewed as an integral part of a complete system rather than just a communications peripheral. A bridge needs to be built between the existing processing system and the EDI network. As such the IOS plan and the IS plan need to be integrated if the full potential of IOS is to be achieved (Cox and Ghoneim, 1994).

3.9.5 Integration of IOS plan with business plan

The ability of IOS to provide strategic advantage requires that the systems are seen as a business solution to corporate requirements rather than a technical solution (Cox and Ghoneim, 1994). The significance of incorporating the EDI strategy with corporate strategy is emphasised by Holland et al. (1992). The importance of the integration is shown by Bjorn-Andersen and Krcmar (1995) who find that companies who adopt EDI for strategic reasons undergo more changes than those who adopt it for operational reasons. The integration of the IOS plan with the business plan resulted in the recognition of additional changes which unlocked the benefits. The need to manage the process is shown by Johnston and Carrico (1988) who conclude from 18 case studies that successful

IOS implementation comes from developing and managing the initiative as a change process.

In summary, the degree to which the implementation plan of IOS is related to the business plan can affect the strategic benefits obtained. In a similar way it can be proposed that organisations who integrate their IOS and business plans will achieve higher degrees of flexibility.

3.9.6 IT expertise existing within the organisation

The degree to which an organisation possesses expertise in IT can affect the levels of benefits that they ultimately obtain from IOS. Holland et al. (1992) find that the degree of expertise in IT has an influence on the extent to which an EDI adoption is successful. Sabherwal and Vijayasarathy (1994) find that the level of IS maturity has a positive impact on how IOS affects organisational performance. Nygaard-Andersen and Bjorn-Andersen (1994), propose that IT maturity makes EDI adoption less expensive and more effective due to the integration benefits which can be achieved relatively easily. Iacovou et al. (1995), in studying small firms, also reach the conclusion that IT management sophistication has an impact on the levels of benefits obtained from EDI.

While the above studies find that IT expertise is positively related to the level of benefits obtained, Cavaye and Cragg (1995) in studying nine case studies find only mixed support for the hypothesis that IS staff experience contributes to the success of IOS. However the majority of research holds that higher levels of IT expertise within an organisation enable IOS to be more successfully implemented. This success is seen in the form of higher levels of benefits relative to other less IT sophisticated organisations. It may be proposed that this organisational factor will influence the level of flexibility, with higher levels of IT expertise resulting in the organisation obtaining a higher degree of flexibility from IOS.

3.9.7 Integration of IOS software with other internal IS

IOS can be integrated with existing internal IS at different levels (Curran, 1991). Swatman and Swatman, (1991), propose a four stage model of EDI integration. The four stages are (1) stand alone PC, (2a) PC up/download, (2b) mainframe to mainframe communications, (3) seamless software and (4) structural integration. Emmelhainz (1990) finds that due to cost constraints many non-initiators choose to implement what has been called 'door-to-door' EDI. In this instance the firm implements relatively few applications on a front-end system that is not integrated to its internal transaction processing systems. In a study of suppliers of component parts to car manufacturers in Australia nearly two-thirds were using PCs to trade via EDI. (Mackay, 1993).

Mackay (1993) finds that the degree of integration between IOS software and internal IS has an impact on the levels of benefits being achieved. The relationship is positive indicating that higher integration results in higher levels of benefits (Cox and Ghoneim, 1994). It is estimated that a company can lose up to 70 per cent of the potential benefits when EDI is not integrated into every facet of business operations (Baker, 1991).

The degree of integration is positively related to organisational size (Hwang, 1991), the length of time IOS are in use (Premkumar et al., 1994), and the adoption of an organisational perspective of the system (Swatman et al., 1994).

In summary, the degree to which IOS software is integrated with existing IS is positively related to the levels of benefits achieved. The degree of integration can be affected by other factors which enable benefits. It can be proposed that the degree of integration might be positively related to the level of flexibility that an organisation achieves from IOS.

3.9.8 External Environment

The state of the external environment can affect the extent to which organisations develop IOS. Johnston and Carrico (1988) find that competitive environment factors influence the degree of strategic IT development that a firm undertakes. Examples of these competitive environment factors include markets in which products or services have a limited life, and industries which are experiencing increased competitive pressure. Sabherwal and Vijayasarathy (1994) similarly find that the degree of environmental uncertainty is a good predictor of the extent of IOS usage. This research indicates that the more turbulent the external environment the more likely it is that an organisation will use IOS.

3.9.9 Longevity of IOS

With the progression of time organisations will obtain more benefits from IOS. One reason for this may be that over time they can integrate IOS with internal systems (Premkumar et al., 1994). However, users are finding that benefits are not progressing at the pace that most reports predicted (Reekers, 1994). It can be proposed that organisations who are using IOS for longer gain increased levels of benefits. In a similar way, it can be proposed that the length of time an organisation is using IOS is positively related to the level of flexibility obtained.

3.9.10 Industry Sector

Different industry sectors are adopting IOS at different rates. Currently in the USA, IOS are most developed in the automotive, aerospace, and retailing sectors (Sokol, 1991). The effects of IOS may differ across industry sectors. For this reason it is proposed that different industry sectors may achieve different levels of flexibility from their IOS.

3.10 Conclusion

IOS are becoming more important to organisations. They provide an avenue through which organisations can achieve a strategic advantage. The benefits that such systems bring to organisations have been documented in pervious research. The ability of IOS to provide organisations with a specific benefit, increased flexibility, is proposed in previous research (Cash and Konsynski, 1985; Scala and McGrath, 1993), but has never been studied specifically.

In attempting to study the relationship between IOS and flexibility, definitions of the two concepts are required. The key characteristics of IOS are that such systems cross organisational boundaries, are based on IT and facilitate the exchange of information electronically between computer systems. A definition of flexibility was presented in chapter 2. The definition is operationalised with respect to IOS in this chapter. This is achieved by classifying research to date on IOS into the four metrics of flexibility; efficiency, responsiveness, versatility and robustness. The combined previous research on IOS investigates the efficiency and responsiveness metrics of flexibility. However research on the versatility and robustness metrics is scant.

The technology used for IOS can have a positive and a negative impact on flexibility. Value added network services and messaging standards enable flexibility because they are designed to allow organisations to connect additional trading partners with relative ease. However, using IOS to trade electronically with more organisations is not as straightforward as it would appear. The existence of multiple messaging standards and VANS restricts organisations from connecting additional trading partner organisations and, thus, restricts flexibility.

Pervious research on IOS has shown that organisations differ in the level of benefits that they achieve from such systems. It has been shown that certain organisational variables are related to the level of benefits that an organisation

achieves. Research to date on IOS indicates that the ideal profile for an organisation seeking to gain maximum benefits from IOS is as follows; a large organisation, who initiates the use of the IOS, adopts the system offensively or proactively, integrates the planning of the IOS with both the IS and business plans, has above average IT expertise in-house, and integrates the IOS software with existing internal software. In addition, the length of time the organisation has been using IOS is positively related to the levels of benefits achieved. It is proposed that since flexibility is a benefit of IOS that these organisational factors might also be related to the level of flexibility that an organisation gains from IOS. The next chapter presents the research objective of this study and outlines the research questions which are derived from it.

CHAPTER 4

The Research Objective

4.1 Introduction

Chapter 3 showed that IOS can alter the capabilities of an organisation in several ways. For the purpose of this study the effects of IOS were grouped in chapter 3 into four main sections; efficiency, responsiveness, versatility and robustness. These groupings were used in order to map previous IOS studies on to the dimensions of flexibility outlined in chapter 2. This mapping of the effects of IOS and the definition of flexibility derived in chapter 2 are a first attempt to build a theory about the relationship between flexibility and IOS. The research is exploratory and, while it is based on prior literature, none of this literature has proposed the same definition of flexibility as this study.

In investigating IOS and flexibility, this study extrapolates from previous studies. Specifically it argues that certain organisational factors identified as being related to the levels of benefits being achieved by organisations from IOS might be applicable to this study given that flexibility is a benefit. Extending previous research from general benefits to a specific benefit may be extrapolating too far. Cognisant of this, 'propositions' rather than hypotheses are proposed in this research. This is in keeping with Marshall and Rossman (1989) who state that 'the purpose of exploratory research is to investigate little understood phenomena and identify or discover important variables to generate hypotheses for further research'. This study presents propositions which, if verified by this research, can be scrutinised further by transforming them into hypotheses.

4.2 The Research Question

The purpose of this study is to investigate whether a relationship exists between flexibility and IOS. The study is exploratory as it deals with an issue that has to date received little specific attention in the literature. The research objective of this study is:

to examine the connection between IOS and flexibility

In chapter 3 it was argued that flexibility from IOS can occur at two levels. First the technology used for the IOS can enable flexibility and second the actual use of IOS can provide flexibility. The first research question addresses the issue of technological flexibility:

RQ 1: to what extent does the technology used for IOS provide flexibility?

IOS technology is composed of three main components; internal software, messaging standards and the telecommunications method. In chapter 3 it was shown that the literature is inconclusive on the extent to which such technologies provide or inhibit flexibility.

The second research question addresses the proposition that the use of IOS might provide flexibility:

RQ 2: to what extent does the use of IOS provide flexibility?

In answering this research question it is necessary to divide flexibility into the different dimensions as shown in Chapter 2. In particular the temporal, range and focus dimensions are further investigated. The temporal dimension is measured in terms of efficiency and effectiveness. The range dimension is the degree to which foreseen and unforeseen changes have been planned for, and is measured

by robustness and versatility. The third dimension, focus, is the extent to which the flexibility is achieved internally or externally to the organisation. Intention, the fourth dimension of flexibility, is researched in the third research question.

Proposition 2(a): the use of IOS improves efficiency
Proposition 2(b): the use of IOS improves effectiveness
Proposition 2(c): the use of IOS improves robustness
Proposition 2(d): the use of IOS improves versatility
Proposition 2(e): the use of IOS improves internal flexibility
Proposition 2(f): the use of IOS improves external flexibility

Chapter 3 showed that previous studies have demonstrated that differences exist between firms in the levels of benefits they achieve from IOS. Specific organisational factors were identified which have been found to be significant in explaining the differences. For the purpose of this research it is proposed that since flexibility is a benefit of IOS, the same organisational factors might explain differences in the degree of flexibility achieved. The third research question is:

RQ 3: what organisational factors influence the variation in the degree of flexibility being achieved by different IOS participants?

In order to adequately address this research question, it is further sub-divided to ask specific questions on the main organisational factors identified in previous studies, as follows:

Proposition 3(a): larger organisations gain significantly higher levels of flexibility relative to smaller organisations
Proposition 3(b): organisations who initiate IOS gain significantly higher levels of flexibility relative to non-initiating organisations

Proposition 3(c): organisations who adopt IOS offensively gain significantly higher levels of flexibility relative to organisations who adopt IOS defensively

Proposition 3(d): organisations with higher levels of IT expertise gain significantly higher levels of flexibility relative to organisations with lower levels of IT expertise

Proposition 3(e): organisations with higher levels of integration between the IOS and IS plans gain significantly higher levels of flexibility relative to those organisations that have lower levels of integration between the IOS and IS plans

Proposition 3(f): organisations with higher levels of integration between the IOS and the business plans gain significantly higher levels of flexibility relative to those organisations that have lower levels of integration between the IOS and the business plans

Proposition 3(g): organisations with higher levels of integration between the IOS software and internal IS gain significantly higher levels of flexibility relative to those organisations that have lower levels of integration between the IOS software and internal IS

Proposition 3(h): organisations who operate in more competitive situations gain significantly higher levels of flexibility relative to those organisations that operate in less competitive situations

Proposition 3(i): organisations who have been using IOS for a longer length of time gain significantly higher levels of flexibility relative to those organisations that have been using IOS for a shorter length of time

4.3 Overview of Research Objective

This chapter has outlined the research objective for this study. From this three research questions have been derived. These have been further divided into propositions which the study seeks to investigate. Propositions are chosen over

hypotheses due to the exploratory nature of the research. The next chapter examines the most appropriate research method to be used given the research objective outlined in this chapter.

CHAPTER 5

Research Method

5.1 Introduction

Chapter 4 outlined the research objective for this study. It emphasised that the research being undertaken in this study is of an exploratory nature. This chapter presents a review of the main standpoints on information system research and concludes that in certain situations a pluralistic research approach may be most appropriate. Exploratory research is a case in which pluralistic research methods might be fruitful. The chapter evaluates the alternative research approaches and methods which are appropriate for exploratory information systems research.

The two most appropriate research methods within the constraints of this study are the survey and case study methods. These two methods complement each other and for this reason a pluralistic research method was adopted. First, a mail survey was conducted among IOS users in Ireland. A mail survey has several potential drawbacks such as low response rates, inappropriate people filling in the questionnaire and possible misinterpretation of questions. Steps were taken to reduce the possible effects of these drawbacks. A sampling frame was compiled, pre-tests of the questionnaire were carried out, the questionnaire was addressed personally to IS managers and non-response bias was tested for.

The second research method used was a case study. In conducting research on IOS the most appropriate unit of analysis is the network. Two inter-company networks are investigated, one centred around a retail grocery network and the other a manufacturing network. The selection of organisations to participate in this part of the study was made on the basis of firms who provided interesting

comments on the questionnaire and also expressed a willingness to co-operate futher.

5.2 Epistemology of Information Systems Research

It is argued that the accumulated research findings in information systems have for the most part been disappointing, especially in areas involving organisational realities (Franz and Robey, 1987). In order to overcome this problem a more careful selection of research methods is called for (Zmud, 1979; Attewell and Rule, 1984; Ives and Olson, 1984). In choosing a research method an understanding of the rationale of the research method is important.

All research is based on some underlying assumptions about what constitutes 'valid' research and which research methods are appropriate (Myers, 1996). One way of uncovering the underlying assumptions is by reviewing the underlying epistemology which guides the research (Klein et al., 1985). Epistemology refers to beliefs about the way in which knowledge is constructed (Hirschheim, 1985). Two opposing views of epistemology exist; positivism and interpretivism (Boland, 1985; Galliers, 1992; Cavaye, 1996).

5.2.1 Positivism

Positivism as portrayed in the information systems is a general term used to denote the scientific approach used in the natural sciences. As such, the positivist approach involves the manipulation of theoretical propositions using the rules of formal logic, so that the theoretical propositions satisfy the four requirements of falsifiability; logical consistency, relative explanatory power, and survival (Lee, 1991). As a result positivist research is premised on the existence of a priori fixed relationships within phenomena which are typically investigated with structured instrumentation (Orlikowski and Baroudi, 1991).

In the West positivism underlies the scientific method (Hirschheim, 1985). Indeed, positivists claim that the scientific method is the only true method of conducting research as the positivist goal of an objective knowledge of the world is what constitutes the difference between science and non-science (Nissen, 1985). The central tenets of positivism are (1) the unity of the scientific method, (2) the search for human causal relationships, (3) the belief in empiricism, (4) the value-free nature of science (and its processes) and (5) the logical and mathematical foundation of science (Hirschheim, 1985).

The unity of the scientific method implies that the accepted approach for knowledge acquisition, the scientific method, is valid for all forms of inquiry. It does not matter whether the domain of study is animate or inanimate objects. Indeed, Popper (1963) argues that for something to be classified as science it has to follow certain conventions, if it does not then it should be regarded as pseudo science. Hirschheim (1985) suggests that all of Popper's examples of pseudo-science are in the human realm and speculates whether all of social science itself might be considered pseudo science under such a view.

The search for human causal relationships reflects the desire to find regularity and causal relationships among the elements of study. The process used is based on reductionism, where the whole is further and further reduced into its constituent parts. Banville and Landry (1989) argue that a monistic view of science is inappropriate for an emerging discipline such as information systems.

The belief in empiricism refers to the strongly-held conviction that the only valid data is that which is experienced from the senses. Boland (1985) disagrees with empiricism and proposes phenomenology as an alternative philosophy of science. Phenomenology as a method of social science stems from the work of Husserl (1931), who argues that positive science was heavily dependent on unchallenged presuppositions which result in it failing to achieve a truly objective status.

Instead phenomena are the essence of our experience, these are not verified empirically, but are grasped through intuition (Boland, 1985).

The value-free nature of science reflects the belief that there is no intrinsic value position in science. The undertaking of science has no relationship to political, ideological, or moral beliefs. It transcends all cultural and social beliefs held by scientists. Gadamer (1975) disagrees with this tenet of positivism and argues that it is impossible to strip away all assumptions to guarantee objective knowledge. The post-positivists maintain that any human observer will always be subject to bias as a result of pervious experience, limitations in knowledge, values, beliefs and attitudes (Vitalari, 1985). From this perspective 'facts are not facts' but really a series of perspectives on reality according to a particular observer (Smith, 1990).

Logic - and more generally, mathematics - provide the foundation of science. They provide a universal language and a formal basis for quantitative analysis - an important weapon in the search for causal relationships. Attewell and Rule (1984) in a review of research on computing and organisations conclude that 'a priori' reasoning which involves proceeding logically from assumptions about principles that describe the social impacts of computing in organisations is unproductive. The reason for this is that they do not expect any problems to be 'solved' definitively, no matter how widely they are investigated.

While each of the tenets of positivism has been subject to attack it still remains the dominant approach to IS research (Orlikowski and Baroudi, 1991). The alternative view of knowledge is that of interpretivism. It has achieved prominence in the study of social science due to the belief that the methods of natural science are, at best, inadequate to the study of social reality (Lee, 1991).

5.2.2 Interpretivism

The focus of IS research questions has changed over the years from technological to managerial and organisational (Benbasat et al., 1987). In keeping with this shift, Galliers (1993) proposes that information systems research should be considered more of a social science or a socio-technical subject, and not simply a technical one. Hirschheim (1985) contends that information systems epistemology draws heavily from the social sciences because information systems are, fundamentally, social rather than technical systems.

Interpretivists argue that the scientific ethos is misplaced in social scientific enquiry because of, (Galliers, 1993; Galliers 1985, after Checkland 1981): (1) the possibility of many different interpretations of social phenomena, (2) the impact of the social scientist on the social system being studied and (3) the problems associated with forecasting future events concerned with human activity given that there will always be a mixture of intended and unintended effects and the danger of self-fulfilling prophecies or the opposite.

Positivism achieves objectivity and testability by stripping the subject of context at the cost of a deeper understanding of what is actually occurring (Kaplan and Duchon, 1988). The interpretative approach in contrast to positivism assumes that people create and associate their own subjective and intersubjective meanings as they interact with the world around them (Orlikowski and Baroudi, 1991). Using an interpretative approach accepts the fact that 'data are subject biased: Knowledge is not a mirror copy of reality since in order to know an object, the subject must intervene on it' (Landry and Banville, 1992).

Interpretivism accepts that the researcher impacts the social system being studied. Indeed, the immersion in context is a hallmark of the interpretative perspective on conducting research (Kaplan and Duchon, 1988). The interpretative approach is equated by Galliers (1993) with phenomenology as espoused by Boland (1985). A phenomenological study always includes the

researcher and the method being used as part of the phenomenon being studied. The end result of a phenomenological study is not a claim to have a proof of its findings, only a reliance on its method and the hope that others will 'see' its descriptions as true and accurate (Boland, 1985).

Given that the subject under study is human nature, repeatability is problematic. As Galliers (1985) mentions this is not a new issue, Heractitus, some two and a half thousand years ago, in identifying the changing underlying character of nature, pointed out that one cannot step into the same river twice. The biggest difficulty in information systems is that while it is possible to look at similar situations, no two organisations will be the same.

5.2.3 Pluralism

Positivism and interpretivism are often proposed as opposing and irreconcilable viewpoints, however this is not necessarily so (Lee, 1991). Post-positivism argues for 'methodological pluralism' - the assertion that there is no one correct method of science but many methods (Morgan 1980; Polkinghorne, 1983; Hirschheim, 1992). This point is argued by Kuhn (1970) who believes that

> 'the pull towards a single methodological perspective, with its clearly defined tools, needs to be resisted because this single perspective designed for research in normal science, overlooks the anomalous quality of human experience. The difficulty for human science arises not from the need to change from one paradigm to another but the need to resist settling down to any single paradigm'.

Hence research does not require conformity; it needs breadth of vision, tolerance and a willingness to accept different approaches and objectives (Mumford, 1991; Orlikowski and Baroudi, 1991).

A further argument for pluralism is provided in that using multiple methods increases the robustness of results because findings are strengthened through

cross validation (Kaplan and Duchon, 1988; Gable, 1994; Cavaye, 1996). This is achieved by using triangulation which broadly defined is 'the combination of methodologies in the study of the same phenomenon' (Denzin, 1978). The purpose of using more than one method is to ensure that the variation reflects the subject being studied and not the research method (Campbell and Fiske, 1959). As such cross validation is achieved when different kinds and sources of data converge and are found congruent (Benbasat et al., 1987, Bonoma, 1985; Jick, 1979; Yin, 1984).

Although triangulation is an important reason for combining methods (Creswell, 1994) additional reasons have been advanced by Greene et al. (1989). These include (1) complementary reason, in that overlapping and different facets of a phenomenon may emerge, (2) developmental reason, wherein the first method is used sequentially to help inform the second method, (3) initiation reason, wherein contradictions and fresh perspectives emerge, and (4) expansionary reason, wherein the mixed methods add scope and breadth to a study.

Pluralism advocates the adoption of more than one research method (Fitzgerald et al. 1985, Fitzgerald, 1991). However many methods exist, and not all are applicable to a particular study. The adoption of particular research methods for a study depends on the objectives of the researcher, the amount of knowledge in the field, and the nature of the topic under investigation (Benbasat, 1989). It is within this context that a pluralistic approach can be chosen or rejected. The next section reviews specific information systems research methods.

5.3 Research Methods in Information Systems

Numerous research methods are proposed for information systems by different authors (Van Horn, 1973; Hamilton and Ives, 1982; Vogel and Wetherbe, 1984; Galliers, 1985; Galliers and Land, 1987; Faroomand, 1987). A classification of

the proposed research methods and whether they belong to the scientific or interpretivist tradition is outlined in Galliers (1992) (Figure 5.1).

5.3.1 Laboratory experiments

Laboratory experiments involve conducting research within an artificial setting where the researcher can assign subjects to treatment and control conditions and can manipulate one or more independent variable to assess their impact on the dependent variables. This results in the researcher having control over virtually all the independent and intervening variables that affect the dependent variables (Stone, 1978). The key benefit of laboratory experiments is that internal validity is high, due to the control which the researcher can exert (Jarvenpaa, 1988; Dickson, 1989).

Scientific	**Interpretivist**
Laboratory experiments	Subjective/argumentative reviews
Field experiments	
Surveys	Action research
Case studies	Descriptive/interpretative
Theorem proof	
Forecasting	Futures research
Simulation	Role/game playing

Figure 5.1: Information systems research approaches (From Galliers, 1992)

The achievement of high internal validity results in a trade-off with external validity (Mason, 1989). The weakness of external validity is a major criticism of laboratory experiments as it may mean that the experiments lack realism (Knorr-Certina 1981; Benbasat, 1989). This point leads Galliers and Land (1987) to argue that such experiments are more applicable in the natural sciences than in information systems. This is because in general, laboratory experiments are less likely to be applicable in the wider societal, or organisational contexts (Lewin, 1951; Galliers and Land, 1988).

5.3.2 Field experiments

Field experiments, or 'quasi-experiments' (Cook and Campbell, 1979) take place in the natural setting of the variables being studied. This makes the experiments more realistic and may result in increased external validity. However, problems occur first in getting organisations to co-operate (Galliers, 1992) and second, replication of the experiment is problematic because the study of social systems involves so many uncontrolled - and unidentified - variables (Cook and Campbell, 1979; Kaplan and Duchon, 1988).

In conducting field experiments it is essential that the researcher has a reasonably clear prior notion of what variables probably matter and how these variables should be measured. Achieving this may be problematic in information systems research because very little research in IS has yet reached the point where testable hypotheses are being put forward. This is not so much a reflection on the research itself but on the difficulties of being explicit about controlled and uncontrolled variables in a novel kind of situation (Antill, 1985).

5.3.3 Surveys

The survey approach refers to a group of methods which emphasise quantitative analysis, where data for a large number of organisations is collected through data collection methods such as mail questionnaires, telephone interviews, personal interviews, or from published statistics, and this data is analysed using statistical techniques (Gable, 1994). Surveys have three distinct characteristics; (1) the purpose is the generation of quantitative descriptions, (2) information is collected by asking pre-defined questions and (3) the information is generally collected from a sample of the study population in such a way as to enable generalisable findings to the population of interest (Pinsonneault and Kraemer, 1993).

One of the benefits of survey research is that it enables the examination of phenomena in their natural settings (Pinsonneault and Kraemer, 1993). Survey research offers advantages over experimental research in that it has the capability to look at a far greater number of variables (Galliers, 1992) and provides increased confidence in the generalisability of results (Jick, 1983). A weakness of survey research is that it only provides a snap-shot of the situation at a certain time, which yields little information on the underlying meaning of the data (Gable, 1994).

5.3.4 Case studies

A case study is a means of researching a particular situation, usually a single organisation (Galliers, 1992). The focus of the research is on describing the relationships that exist and understanding the dynamics present within the particular situation (Eisenhardt, 1989). Case studies are appropriate where the objective is to study contemporary events and where it is not necessary to control behavioural events or variables (Yin, 1984). Case study research can be used in either an interpretative or positivist manner (Cavaye, 1996).

The strength of this research method is that it enables the capture of reality in considerably greater detail than is possible with either experiments or surveys (Galliers, 1992). Its weaknesses include the lack of generalisability, the potential for bias by the researcher in interpreting the data and the difficulties in distinguishing between cause and effect.

5.3.5 Theorem proof

This research approach involves the capturing of application areas from fields such as computer science that otherwise would not be identified (Vogel and Wetherbe, 1984). It is concerned with the development and testing of theorems at

the technical end of the socio-technical spectrum. Theorem proof has limited applicability to social systems research (Galliers, 1992).

5.3.6 Forecasting and futures research

Forecasting and futures research represent, respectively, the scientific and interpretivist aspects of this form of research (Galliers, 1992). Forecasting uses statistical techniques on past data to extrapolate likely future trends. Futures research uses the Delphi method or similar methods to provide convergence among expert opinion. The validity of the research is dependent on the precision of past data in the one case and the expertise of the scenario builders on the other. An additional limitation includes the unpredictability of environmental factors.

5.3.7 Simulation and game/role playing

The purpose of this research approach is to enable the researcher to generate appropriate random variables (Chatfield, 1988). The main benefit of this research method is that it provides the possibility of solving problems which are difficult or impossible to solve analytically in reality. The main weakness is the difficulty in devising a simulation that accurately reflects the real world situation it is supposed to replicate (Galliers, 1992).

5.3.8 Subjective/argumentative research

This research method is creative research based more on opinion and speculation than observation (Vogel and Wetherbe, 1984). It starts with narrative descriptions within which the imagination is allowed to range freely and widely over many possibilities (Remenyi and William, 1996). Positivists question whether this method is genuinely research. Its strengths lie in the creation of new ideas and

insights. Its weaknesses arise from the unstructured, subjective nature of the process (Galliers, 1992).

5.3.9 Action research

Action research stems from the behavioural sciences and is based on the principle that the researcher is within the field of that research and becomes a partner in the action and process of change (Wood-Harper, 1985). It combines pure research (observing) with action (participation) (Cavaye, 1996). The researcher enters the field with the intention not only to observe and record, but also to take part actively in attempting to solve the problem at the site (Suman and Evered, 1978; Mansell, 1991).

A strength of this research method is that the researcher's biases are made overt in undertaking the research (White, 1985). The weaknesses are similar to those of case study; the lack of generalisability, the potential for bias by the researcher in interpreting the data and the difficulties in distinguishing between cause and effect.

5.3.10 Descriptive/interpretative research

This research method may be equated with the phenomenological school of thought (Husserl, 1936; Boland, 1985). It argues that all that can ever be known are phenomena. However, once the phenomena have been understood correctly, all that there is to be known is known.

The strength of this research method is its ability to represent reality and to continually question the presuppositions of the study. The weaknesses relate to the skills of the phenomenologist and their ability to identify their biases and unheralded assumptions (Galliers, 1992).

5.4 Choosing a Research Approach

The purpose of this research is to study the connection between IOS and flexibility. Chapter 3 demonstrated that the relationship between IOS and flexibility has not been studied in detail in previous IOS research. As such, this study, being the first to specifically address the issue, is exploratory in nature. The purpose of exploratory research is to investigate little understood phenomena and identify or discover important variables to generate hypotheses for further research (Marshall and Rossman, 1989). Exploratory research has tentative theory building as its aim.

Galliers (1992) suggests that theorem proof, laboratory experiments and field experiments are not appropriate for theory building. Consequently these research methods were deemed inappropriate for the study. Forecasting and furtures research were rejected, the former because adequate data was not available, and the latter because experts in the area of interest were not identifiable. Simulation and game/role playing were rejected due to the impossibility of generating a model that adequately represented the reality being investigated.

Subjective/argumentative research was used during the review of the literature to provide a multi-dimensional definition of flexibility. The research method was deemed inappropriate for further investigation due to the unavailability of data relating expressly to flexibility in the IOS literature.

After eliminating the inappropriate research methods, three remained; survey, case study and action research, each of which has been proposed as being appropriate for exploratory research. Jarvenpaa (1988) proposes that a case study or action research are appropriate in aiding theory building. Marshall and Rossman (1989) also suggest that case studies are suitable for preliminary

research. Galliers and Land (1988) in response to Jarvenpaa propose that survey research is equally valid for theory building.

While action research is an appropriate research method it was not used due to the fact that the researcher was not an active participant in an IOS. The two remaining research methods were case studies and survey research. The choice of the most appropriate research method is dependent on the specific problem being researched (Hirschheim, 1992).

The survey method offers many potential benefits for this study. In examining the relationship between IOS and flexibility the survey method contributes to the body of knowledge by providing a snapshot of current views on the subject (Galliers, 1992). The survey enables generalisable conclusions to be reached (Jick, 1983). These conclusions may then be used to form the basis for mapping out the extent to which IOS and flexibility are related. In addition, conducting a survey enables relationships that are common across the population to be discovered (Gable, 1994).

The case study method in contrast offers alternative benefits. It enables a more in-depth understanding (Bonoma, 1985) of the relationship between IOS and flexibility. It provides avenues for contextual understanding (Gable, 1994) and provides the ability to capture the reality of the relationship between flexibility and IOS in greater detail than is possible with the survey method (Galliers, 1992).

Both the survey and case study provide viable research methods for this study. However, each of these research methods have weaknesses as outlined in the section on research methods in this chapter. Attewell and Rule (1991) highlight the 'complementarity between survey and fieldwork approaches to studying information technology' , stating that 'each is incomplete without the other'. This interconnection between the two research methods is shown by Gable (1994). He

suggests that if used in tandem the strengths of one method can counter balance the weaknesses of the other (Figure 5.2).

	Case study	Survey
Controllability	Low	Medium
Deductibility	Low	Medium
Repeatability	Low	Medium
Generalisability	Low	High
Discoverability (explorability)	High	Medium
Representability (potential model complexity)	High	Medium

Figure 5.2: Relative strengths of case study and survey methods (Gable, 1994)

The main strength of the survey method over a case study is its generalisability (Jick, 1983). The weakness of a survey is that it only provides a static snap-shot, which yields little information that enables the discovery of the underlying meaning of the data (Gable, 1994). This discoverability, the ability to capture reality in considerable detail, is one of the key advantages of case studies (Galliers, 1992).

For the purpose of this study both survey and case study methods were used. The main reason for using both is the synergistic benefits afforded by the complementary nature of the two methods. In particular, the two methods were combined for developmental reasons (Greene et al., 1989). As such the survey is used first to aid more informed questioning during the case study research.

5.5 The Survey

The survey method can be conducted in one of four ways; by personal interviews, by panel interviews, by telephone, or by mail (Kerlinger, 1986). Personal and panel interviews were rejected for this study for two reasons. First, due to the high cost that would have been involved as the population of interest is geographically dispersed around Ireland. Second, due to time constraints it would

only be possible to interview small numbers which would reduce the generalisability of the results obtained.

The telephone interview was not chosen for this study, as it possessed disadvantages over the mail questionnaire without any demonstrable advantages. The disadvantages are first, response errors are normally higher than for mail questionnaires (Weiers, 1984). It was believed that the response error might be high in this study as the interviewees being contacted were managers and the busier ones were more likely to be unwilling to participate in a telephone interview. The second disadvantage of telephone interviews is that they are more time consuming on the researcher relative to mail questionnaires and this results in smaller sample sizes which in turn reduces the generalisability of results obtained.

The main advantages of mail questionnaires relative to other survey methods are; (1) low cost, (2) lower degree of response error, (3) allowing respondents to complete the questionnaire in their own time, and (4) the elimination of interviewer bias (Weiers, 1984). However, the mail questionnaire has potential disadvantages that must be guarded against. These are; (1) the construction of a suitable mailing list, (2) the inability of the researcher to assist the respondent with questions which may require clarification, (3) lack of control over who fills out the questionnaire, (4) non-response error (Weiers, 1984; Kerlinger, 1986). In this study attempts were made to reduce the impact of these disadvantages. The steps taken will be illustrated in the subsequent paragraphs of this section.

5.5.1 Construction of the mailing list

To ascertain the relationship between IOS and flexibility, the research objective of this study required that respondents to the mail questionnaire be users of IOS. As such the study required a mailing list that targeted solely organisations with IOS. The starting point for the construction of the mailing list for this study was a

list of members of the Electronic Commerce Association of Ireland. This is a non-profit making association whose main objective is to facilitate the more widespread use of electronic commerce. A list of 129 members was obtained of which 104 were IOS users. The remainder were organisations which either provided support services such as software consultancy or value added network services (VANS).

In order to increase the number of organisations in the mailing list the VANS operating in Ireland were contacted. A list was obtained from the Electronic Commerce Association of Ireland (ECAI). The rationale for contacting these companies was that one of the essential IT features of IOS is a telecommunications link and the one most commonly used is a VANS. Five service providers were approached to try and obtain their customer list. They were first contacted by means of a personalised letter and then followed up by telephone. The two largest network service providers in Ireland, Eirtrade and Postgem, provided customer listings. The other three, despite repeated attempts, were unwilling to participate due to the perceived confidentiality of the information that was being sought. Accurate information regarding the market-share that the three non-partaking VANS possessed was impossible to obtain. However, in discussions with industry sources it was ascertained that their relative market share is believed to be quite low.

The three lists obtained from the ECAI, Eirtrade and Postgem were combined and duplications were eliminated. This resulted in a final mailing list of 337 organisations. This list of organisations represented the most complete mailing list that the researcher could obtain.

It is important to note that this sample, therefore, did not represent a random sample but rather a purposive, non-probabilistic one. Not using a random sample is criticised by Kraemer and Dutton (1991). However, Mason (1991) suggests that rather than criticising the lack of true random sampling, researchers should strive to construct samples that allow the most powerful inferences to be made.

Therefore, one of the principles guiding the sample selection for this study was that of ensuring that participants were users of IOS. Such a strategy is recommended by Eisenhardt (1989) who recommends that samples be chosen for theoretical reasons so that the phenomenon of interest may be more likely to be present to a significant degree.

5.5.2 Pretesting of the Questionnaire

The pretesting of any research instrument enables the achievement of more consistent results (Hufnagel and Conca, 1994). In particular, pretesting provides the researcher with the potential to reduce respondents' need for clarification, the second potential disadvantage of mail surveys. In pre-testing the researcher is afforded the opportunity to observe questions that the respondent has difficulty in understanding. These questions can then be re-worded to remove ambiguities.

The questionnaire for this study was first pre-tested with other IS researchers. Next it was personally administered by the researcher to three IS professionals. In addition it was given to three people with no experience in IS to check for possible ambiguities in the wording of the questions. As a result of this pre-testing a number of changes were made with regard to the wording of specific questions.

5.5.3 Questionnaire respondents

One of the potential disadvantages of mail surveys is that the researcher cannot control who fills out the questionnaire. One way to reduce the chances of having an inappropriate person fill out the questionnaire is by addressing the questionnaire to the person who is perceived to be the most suitable. In conducting this research each questionnaire was addressed to either the IS manager, the IT manager or the person responsible for IOS within the

organisation. Each questionnaire was accompanied by a letter addressed personally to the intended respondent.

The personalisation of the letter was achieved in a number of ways. A substantial number of the companies listed by Eirtrade, Postgem and the ECAI included a contact person. In cases where no contact person was provided, alternative means were used to find the name of the IS manager in the company. For large companies 'FactFinder', a database of the top 3,000 companies in Ireland, was used. For smaller organisations the 1996 Kompass directory of Irish organisations was used. If neither of these sources produced a name, the companies were contacted by phone and the name of the person responsible for IT within the organisation was obtained. By ensuring that the questionnaire was delivered to the targeted person it was hoped to exert control over who actually filled out the questionnaire.

The possibility still remained that the person who received the questionnaire might delegate someone else to complete it. In order to monitor this possibility, the person filling out the questionnaire was asked to indicate their name, and position in the organisation. The vast majority of the questionnaires were completed by the person to whom it was addressed. Where delegation occurred, the questionnaire was answered by a person with responsibility for IOS rather than the IS manager.

5.5.4 Administrating the questionnaire

The questionnaire (Appendix 1) was mailed in mid July 1996 along with a personalised letter which explained the purpose of the study (Appendix 1). One month later a follow-up questionnaire accompanied by another personalised letter (Appendix 1) was administered to those who had not responded. In all, 156 completed questionnaires were received, giving an overall response rate of 46.3%, of which 150 were usable, giving a usable response rate of 44.5%. The

unusable responses consist of 4 replies from organisations who have a policy not to complete mail questionnaires and 2 organisations where the person to whom the questionnaire had been addressed had left the company and it had not been directed to someone else. The high response rate might be explained by the fact that individuals in the sample were targeted and were likely to find a questionnaire on IOS of interest. Also, the pertinence of the topic and the lack of previous research on Irish firms in this area may have helped. In addition, a summary of the survey results was offered to those who responded. The synopsis of the results was professionally formatted using a desk-top publishing software package and posted to those who requested it (Appendix 2).

5.5.5 Non-response bias

In administering a mail questionnaire the possibility arises that those who respond are non representative of the sample population. Bias may be introduced by respondents who may have a different profile than non-respondents along important variables.

One way to test for non-response bias is to assume that late-respondents can be taken as reasonable 'surrogates' for non respondents (Oppenheim, 1966; Wallace and Mellor, 1988). The characteristics of these late respondents can then be compared against earlier respondents to see if a significant difference exists. Alternatively, the way in which these late respondents answered the questions asked in the questionnaire can also be compared with early returns to see if they differ. A significant difference in either of these tests would indicate the presence of a non-response bias.

For the purpose of this study, late respondents were taken to be the 45 usable responses that were returned as a result of the reminder and second questionnaire sent out in mid August 1996. As these were non-respondents to the original mailing, it is believed that it could reasonably be assumed that the characteristics

that prevented them from responding to the first mailing, were similar to the characteristics of those who did not reply to either mailing.

The characteristic of responding and the 'surrogate' non-responding organisations were compared in terms of annual turnover, number of employees and years using IOS. The Mann-Whitney U test was used to test the null hypothesis that both sets of respondents have the same characteristics. These tests show that no significant difference exists in the chosen organisational characteristics between respondents and non-respondents (Figure 5.3).

Characteristic	**Degree of significance between respondents and non-respondents**
Years using IOS	.5635
Annual turnover	.8388
Full-time employees	.6161

Figure 5.3: Test for non-response bias on the basis of organisational characteristics

In addition to organisational characteristics, non-response bias can be checked by comparing responses to questions requiring opinions or subjective answers (Oppenheim, 1966; Wallace and Mellor, 1988). For this purpose the answers which respondents and the 'surrogate' non-respondents gave to questions 14,15 and 18, were compared. These questions were chosen as these were the questions which sought to measure flexibility and represented a key component in the survey instrument. It was believed that any bias detected in the answering of these questions was likely to have a significant impact on the study. The Mann-Whitney U test was used to test the null hypothesis that both sets of respondents had the same characteristics. These tests showed no significant difference exists between the beliefs of respondents and non-respondents concerning the relationship between IOS and flexibility (Appendix 3).

5.5.6 Structure of the questionnaire

The questionnaire (Appendix 1) begins with a definition of IOS as suggested by Hufnagel and Conca (1994) in order to aid the reduction of context-related errors and biases. Questions 3,4,9,11,12,13 are concerned with finding out information on the information technology used for IOS. The answers to these questions are used to ascertain the extent to which the technology for IOS is seen to have a positive or a negative impact on flexibility.

Questions 14,15 and 18 contain 33 questions which measure the different metrics of flexibility as operationalised in chapter 4. The 33 individual questions on flexibility are also combined to provide an overall measure of flexibility. This is done in the same way that Raymond and Bergeron (1996) combine individual measures of EDI advantages to obtain an overall measure of 'EDI advantages'. In addition the individual questions are combined to give measures for the four metrics of flexibility and to measure the degree of internal and external flexibility.

In a list of thirty three questions, a potential exists for position bias (Weiers, 1984). This is where respondents cease to look at the question but just agree or disagree with all of the statements. To avoid the potential for such bias some of the questions concerning flexibility were reversed, with some stated positively and others stated negatively. Before calculating the metrics of flexibility the negatively stated questions were reversed. This was done to provide directionally consistent answers to the 33 questions which enables the combination of the individual questions.

Questions which sought information on organisational factors were dispersed throughout the questionnaire. Question 2 ascertained the longevity of IOS usage and question 5 whether the organisation initiated the adoption of the IOS or not. Question 8 measures the degree of IT expertise in the organisation and the level of integration between the IOS plan and both the IS and business plans. Question

17 measures the degree of integration between the IOS software and internal IS. Questions 20 to 23 gauge additional organisational factors including the number of employees, annual turnover, the sector the organisation operates in and the competitiveness of the environment in which the organisation competes.

5.6 Case Studies

The second part of this study consists of two case studies. This research method was chosen to augment the survey research (Gable, 1994). In particular, the case studies were undertaken to enable more in depth analysis of the findings from the survey (Kaplan and Duchon, 1988; Lee, 1991). A case study is a means of researching a particular situation, usually a single organisation (Galliers, 1992).

The study of IOS requires a network perspective (Kambil and Short, 1994; Fredriksson and Vilgon, 1996) since the system crosses organisational boundaries. Venkatraman (1994), acknowledging this fact, argues that in the instance of IOS there is a need to carry out research across the value system and not just within one organisation. As such the unit of analysis for a case study in IOS is the inter-organisational network.

The primary method of data collection used was a personal interview. Information regarding IOS usage was provided for the interview by the questionnaire completed by each organisation in the first part of the study. Personal interviews are well suited for exploratory research because they allow expansive discussions which illuminate additional factors of importance. The information gathered is likely to be more correct than information collected by other methods since the interviewer can avoid inaccurate or incomplete answers by explaining the questions to the interviewee. Also the personal interview can enable a rapport to develop between the researcher and the respondent which can give the researcher much greater insight into issues than would be possible by using a postal questionnaire.

To ensure that there was a high degree of consistency in the questions asked and that the researcher covered all the relevant areas a structured type of interview was used. McCracken (1988) states 'the use of a questionnaire is sometimes regarded as a discretionary matter in the qualitative research interview. But, for the purpose of the long qualitative interview it is indispensable'. According to McCracken (1988) the questionnaire fulfils several functions: (1) it ensures that the investigator covers all the terrain in the same order for each respondent, (2) it helps to manufacture distance between the researcher and the interviewer and (3) it establishes channels for the direction and scope of discourse.

For these reasons the researcher decided to make use of a standardised open-ended interview (Patton, 1980). The interview guide used in this study is shown in appendix 4. The main areas covered included, (i) the type of IOS being used, (ii) the technological flexibility of the IOS, (iii) organisational flexibility, (iv) IOS and organisational flexibility and (v) the IOS and the flexibility of the value chain. While the questionnaire provided structure in each interview areas that were believed to be of interest were explored in more depth through additional questions. The sections of the questionnaire provide a framework for comparing and contrasting the differing viewpoints of the organisations interviewed.

The interviewee in each organisation was the individual with responsibility for the IOS within that organisation. Each interview was conducted in person at the organisation's premises. The interviews lasted between 40 minutes and 1.5 hours with the average length being 50 minutes. In order to aid subsequent analysis all of the interviews were recorded, with the interviewee's consent, by Dictaphone and subsequently transcribed.

5.7 Conclusion

In conducting exploratory studies several research methods are appropriate and may be used in conjunction with each other. For the purpose of this study a pluralistic research approach was chosen which combined the survey and case study research methods. This pluralistic approach was taken because of the synergistic benefits which a combination of a survey and case studies provide. The first part of the research, a mail survey, sought to map out, at a generalisable level, the relationship between flexibility and IOS. The case studies were designed to provide more detail on these relationships. The research findings of the survey are discussed in chapter six and the case study analysis is presented in chapter seven.

CHAPTER 6

Survey

6.1. Introduction

This chapter presents the findings of the survey. First, the statistical tests used and the rationale for using them are presented. A detailed profile of the orgnisations who responded is then given. The technological flexibility of IOS in terms of transmission methods, messaging standards and degree of software integration is discussed. This is followed by the results from the survey which show that IOS do enable the majority of organisations to gain increased levels of organisational flexibility. As part of the exploratory nature of the study the next section outlines and discusses possible drivers or characteristics of organisations which enable them to achieve higher levels of organisational flexibility from their IOS. The chapter closes with overall conclusions based on the survey stage of this research. These conclusions form the basis for more detailed analysis in the case studies which are discussed in chapter 7.

6.2. Analysis

The results of the questionnaires were analysed using SPSS version 6.0. The responses were first analysed using standard statistical measures (means, standard deviations and frequencies). For more advanced statistics non-parametric tests such as the Mann-Whitney U test and the Kruskal-Wallis test were used. These non-parametric tests were chosen over equivalent parametric tests since some of the data set did not meet the conditions required for the latter. Specifically, the data does not meet the requirements with respect to normality of distribution and homogeneity of variance (Conover, 1980).

Measures of association are also calculated to indicate the degree of association where statistically significant differences are found. These measures provide estimates as to the strength and direction of association between independent and dependent variables, thus complementing the tests of statistical significance. These measures can take on a value between 0 and +1, or in some cases between -1 and +1 (negative values imply an inverse relationship). The closer the absolute value is to 1, the stronger is the association, whereas a score of zero generally implies no relationship between the variables.

Numerous measures of association exist, and their correct usage depends on the context and nature of the data. For example, in situations where both variables are measured in at least an ordinal scale, Conover (1980) suggests either the Spearman's r or Kendall's tau measure of association tests. Both achieve the same end and are interchangeable. For consistency the Spearman's r measure was used in the appropriate situations throughout the analysis. The appropriate measure for nominal scale variables is lambda (λ). Lambda indicates the extent to which knowledge of the independent variable allows a reduction in error in predicting the value of the dependent variable (Siegel and Castellan, 1988).

6.3. Profile of organisations responding

Given the exploratory nature of the study, sections of the questionnaire sought to build up a profile of each organisation who responded. This enables comparisons to be made between organisations with different profiles on the basis of the degree of flexibility they are obtaining.

6.3.1 Respondents

The extended effort placed on ensuring that the questionnaire reached the person responsible for IS, outlined in chapter 5, appears to have been rewarded on the basis that 47% of those responding hold the position of IS or IT manager (Figure 6.1). It

was expected that smaller organisations would not have a dedicated IS or IT manager but instead that this function would be overseen by a manager as part of their job description. This is found to be the case as the variety of job titles in Figure 6.1 shows.

The vast majority of the respondents were of management rank (78%). If Financial Controllers / Accountants are included then 89% of respondents are managers. The 11% remaining provided no job title or name when completing the survey. Given that the questionnaire was personally addressed to the manager in charge of IS within the company, it is highly likely that a large proportion of these 11% are managers.

As with all mail surveys it is impossible to detect hidden delegations - situations where the person filling out the questionnaire signs it on behalf of the individual for whom it was intended. Even allowing that this may have occurred in a small number of instances, it can be concluded that the vast majority of respondents hold a management position. Given the levels of responsibility that managers normally have within organisations, it is fair to assume that their position enables them to provide knowledgeable answers to the questions posed.

Job Description	Number	% of Total
IT or IS Manager	70	47%
Manager	23	15%
Financial Controller / Accountant	16	11%
Director	15	10%
Managing Director / CEO / General Manager	9	6%
No Title Provided	17	11%

Figure 6.1: Job descriptions of respondents

6.3.2 Annual turnover

The types of organisations responding to the survey range from small companies to large corporations (Figure 6.2). Twelve percent of the organisations have an annual turnover of less than IR£250,000 while 14% have a turnover in excess of IR£300

million. Organisations replying cover a comprehensive spectrum in terms of annual turnover. This is shown by the fact that the smallest turnover in the sample is IR£120,000 while one of the respondents is the third largest organisation in Ireland. The mean annual turnover value is IR£370 million with a standard deviation of IR£1,257 million.

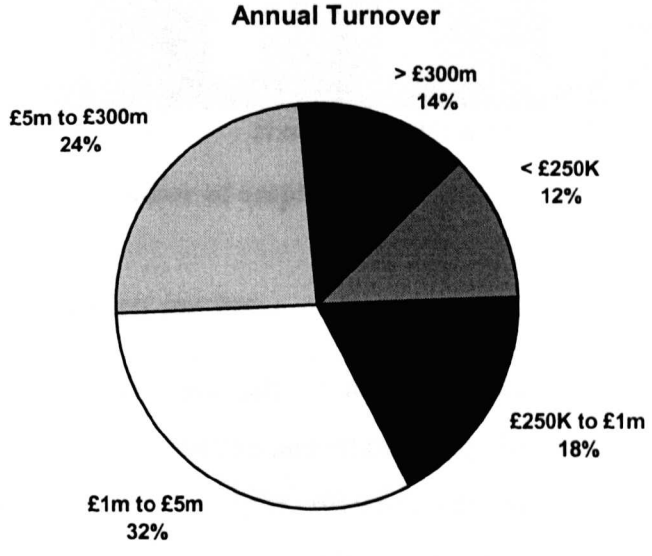


Figure 6.2: Annual turnover of organisations

6.3.3 Employee numbers

The dispersion in the size of the organisations responding is further shown in Figure 6.3 which illustrates the number of people employed full time. Fourteen percent have 40 employees or fewer, while 10% have over 1000 employees. The minimum number of employees among respondents is 10 while the maximum is 50,000. The mean of the organisations responding is 936 employees with a standard deviation of 4,304 employees.

The spread of organisations in the sample, both in terms of annual turnover and employee numbers, is beneficial as it provides data on organisations from SME right up to large multinationals. Given the exploratory nature of this research, the breadth of different experiences of IOS provides inclusive data along the complete spectrum of Irish organisation size.

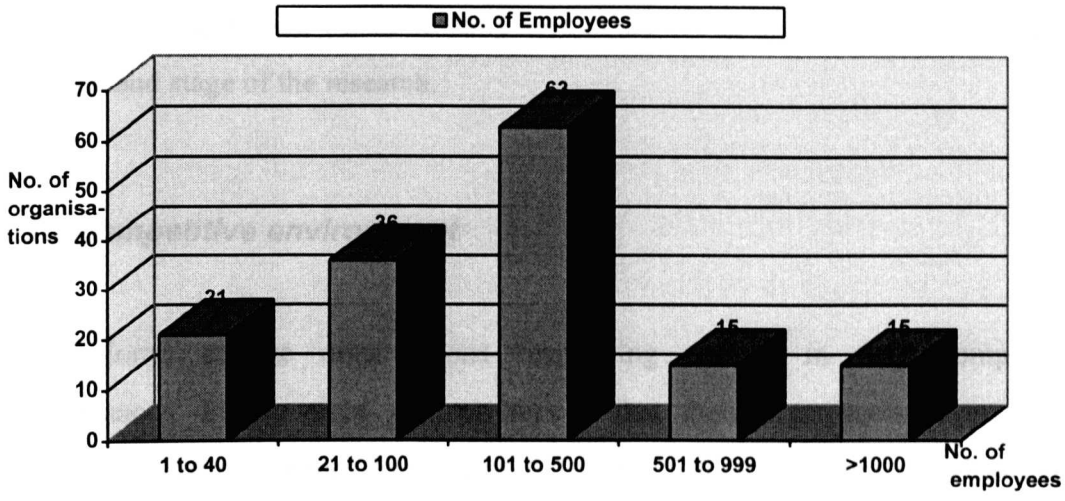


Figure 6.3: Number of employees

6.3.4 Business sector

The responding organisations are concentrated in two main business sectors - manufacturing/production and wholesaling/distribution (Figure 6.4). This finding is in keeping with previous research carried out by the Electronic Commerce Association of Ireland. In a study of the top 1,000 companies in Ireland in 1994 they found that the most prevalent industry sector using EDI was manufacturing at 30.3%, followed by wholesale & retail distribution at 18.8%.

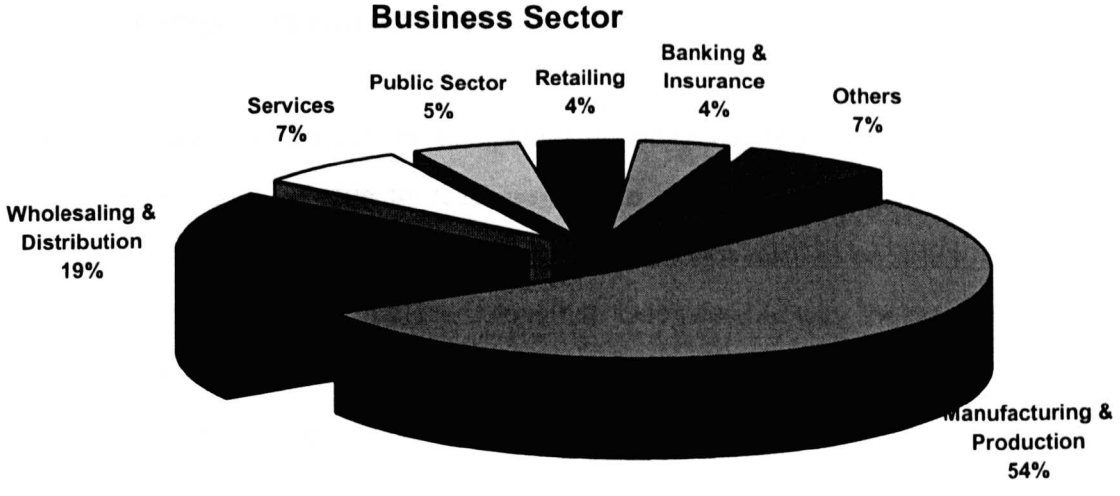


Figure 6.4: Business sector

These figures provide a current representation of the main industries using IOS. This is useful for determining which industry sectors should be the subject of case studies in the second stage of the research.

6.3.5 Competitive environment

The majority of the organisations responding operate in very competitive circumstances. Eighty eight percent believe that their organisation operates in situations of intense competition (Figure 6.5). Only 6% of organisations operate in a climate that is not intensely competitive. Further evidence of the difficulties which organisations face is shown in that 43% of organisations operate in circumstances where their competitors' actions are highly unpredictable. In addition, 42% operate in markets where customer tastes change rapidly.

Your organisation operates in an environment:	**Agree**	**Disagree**
that requires a high degree of diversity in marketing	63%	19%
that requires a high degree of diversity in production	48%	28%
in which customers' tastes change rapidly	42%	28%
in which competitors' actions are highly unpredictable	43%	19%
of intense competition	88%	6%

Figure 6.5: Competitive environment

These figures show that in order to operate in today's competitive environments organisations need to be able to react quickly to changes initiated by both their competitors and their customers. In addition, organisations need to be able to change their marketing and production plans if required. One possible way for organisations to address these changing requirements more effectively is by using IOS. The following sections provide data on IOS used by organisations.

6.3.6 Type of IOS used

The definition of IOS adopted in chapter 3 is designed to be broad and inclusive. However, in order to be able to analyse the results in the most meaningful manner, a question classifying the specific type of IOS being used was included. While it is recognised that an organisation is likely to have more than one type of IOS, the respondents were directed to answer subsequent questions in the survey with regard to one, and only one, type of IOS. The inter-organisational system chosen is the highest one ranked on the list given (Figure 6.6). The list was arranged this way on the basis of technical complexity, with EDI being the most complex.

The vast majority of the organisations (80%), are using EDI. The prevalence of EDI can be explained on the basis of the purposive sample and the fact that other forms of IOS, such as the internet, were still relatively immature at the time the survey was conducted.

Type of IOS	Number	%
Electronic Data Interchange (EDI is defined as the transfer of commercial or administrative transactions using an agreed standard to structure the transaction or message data from computer to computer)	121	80
Letting a trading partner query your IS or database	7	5
Query of a trading partner's IS or database	5	4
Transfer of files e.g. spreadsheets, word processing documents	14	9
Electronic Funds Transfer & Financial Information	3	2

Figure 6.6: Type of IOS

6.3.7 Length of time using IOS

The length of time that the organisation has been using IOS was measured (Figure 6.7). The majority (66%) of organisations have IOS for 3 or more years. Only 5% have IOS for less than one year. Thus, the majority of the organisations who responded can be seen to be familiar with IOS on the basis of the length of time that they have been using them.

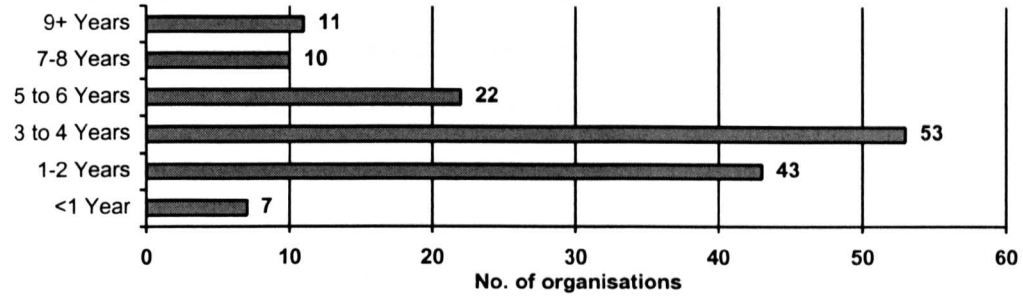


Figure 6.7: Years using IOS

6.3.8: Initial reason for adopting IOS

The most important reason for adopting IOS is a desire to improve the level of customer service, followed by the desire to speed up information transmission (Figure 6.8). The reasons given for adopting IOS provide useful reference points for later comparison to the flexibility metrics obtained for each organisation.

Reason for adopting IOS (Scale from 1 = strongly disagree to 5 = strongly agree)	**Rank**	**Mean**
improve the level of customer service	1	4.12
speed up information transmission	2	3.95
requested by a trading partner	3	3.73
improve productivity	4	3.69
keep up with competitors	5	3.61
increase the accuracy of the data	6	3.56
gain a competitive advantage	7	3.55
decrease costs	8	3.08
facilitate better cash management	9	3.04
increase sales	10	2.69
enable the offering of a greater product range	11	2.45

Figure 6.8: Reasons for initially adopting IOS

6.3.9: Types of trading partners

Inter-organisational information systems can link organisations in different positions in the value chain. They can extend forward to customers, backwards to suppliers and can also connect indirect suppliers of the value chain such as banks and transportation companies. At an exploratory level the survey sought to measure the

extent to which organisations have established IOS linkages with different types of trading partners. Ninety two of the 150 organisations surveyed, or 54%, started using IOS initially with customers (Figure 6.9). This makes connecting to customers the most common initial type of tie using IOS.

As organisations become familiar with IOS they often expand its usage by adding other types of trading partners. The use of IOS has been extended to include a number of different types of organisations. This can be seen in the difference between the number of current trading partners as against initial ones in Figure 6.9. A variety of additional types of trading partners have been connected using IOS by organisations who have expanded IOS usage. While links to all of the different types of trading partners increased, connections to suppliers and financial institutions expanded more.

	Initial Trading Partner(s)		**Current Trading Partners**	
Types of Trading Partners	**Number***	**%**	**Number**	**%**
Customers	92	54	104	38%
Suppliers	23	14	47	17%
Financial institutions	23	14	45	17%
Other companies within your organisation	21	12	38	14%
Transportation companies	5	3	19	7%
Distributors	3	2	16	6%
Others	3	2	3	1%

*Some organisations began using IOS initially with more than one organisational category and this accounts for the number of initial trading partners being 170 while only 150 organisations responded to the survey.

Figure 6.9: Types of trading partners

The extension of IOS to additional types of trading partners is concentrated among 41% of the responding organisations. Eighty eight organisations (59% of respondents) communicate with only one type of trading partner. These organisations were asked why they do not expand the use of IOS to additional types of firms. 73% of these organisations intend to extend the IOS to include additional trading partners in the future (Figure 6.10). For 37% of these firms there is currently no reason to

connect other organisational types. Some organisations have still not completed the connection of all the firms of the initial trading partner type, e.g. suppliers or customers and this stops 28% of organisations from extending the use of IOS to other types of trading partners. The cost of connecting additional organisational groups is not hindering the process, with only 19% identifying it as an obstacle.

Your organisation is using an IOS with only one type of trading partner because	**% Agree or Strongly Agree**
It is planned to extend the IOS to additional trading partners in the future	73%
Currently no reason to connect additional types of trading partners	37%
Connection of organisations from the initial trading partner group to the IOS is not complete	28%
Currently not cost effective to connect additional types of trading partners	19%

Figure 6.10: Reasons for trading with only one type of trading partner

6.3.10 Types of transactions conducted via IOS

Invoices are the most commonly exchanged documents via IOS, being traded by 60% of respondents (Figure 6.11). Forty three percent of organisations using IOS to send invoices are sending between one and twenty percent of their total amount of invoices through the system. Similar percentages of other documents are being transported via IOS. The only exception to this is bank statements, where 43% of organisations receive between 81 to 100% of their bank statements electronically. This can be explained by the fact that organisations deal with a small number of banks and therefore achieving a high percentage is relatively easy.

6.3.11 Sharing of IOS benefits between participants

Previous research (Benjamin et al., 1990, Wang and Seidmann, 1995) in IOS indicates that the benefits are not always shared equally between participating firms.

In this survey 29% believe that the benefits are not shared equally, while 49% believe they are shared equally (Figure 6.12). The figure indicates that, of those who expressed an opinion, the majority believe that the benefits of the IOS are shared equally.

	1-20%	21-40%	41-60%	61-80%	81-100%	Total No. of companies
Invoice	40 (43%)	20 (22%)	12 (13%)	15 (16%)	5 (6%)	92 60%
Electronic Funds Transfer	30 (41%)	14 (19%)	7 (9%)	15 (20%)	8 (11%)	74 49%
Financial Information	22 (41%)	11 (20%)	5 (9%)	12 (22%)	4 (8%)	54 36%
Purchase Order	22 (42%)	9 (17%)	7 (13%)	10 (19%)	5 (9%)	53 35%
Price Catalogue	24 (47%)	12 (23%)	6 (12%)	7 (14%)	2 (4%)	51 34%
Sales	20 (42%)	10 (21%)	11 (23%)	6 (12%)	1 (2%)	48 32%
Bank Statement	15 (33%)	3 (6%)	4 (9%)	4 (9%)	20 (43%)	46 31%
Others	7 (58%)	0 (0%)	2 (17%)	2 (17%)	1 (8%)	12 8%

Figure 6.11: Types and percentages of transactions conducted using IOS

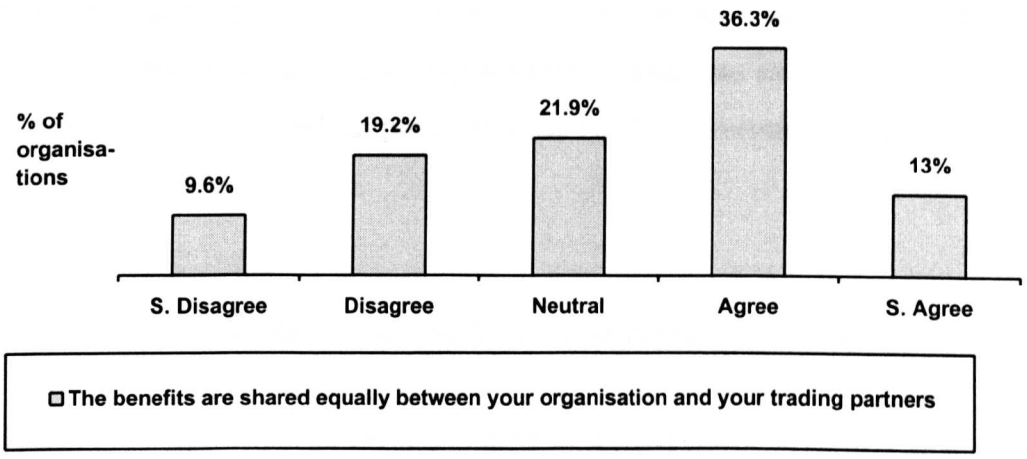


Figure 6.12: Degree to which the benefits of the IOS are shared equally

This section provided background data on the organisations who responded to the questionnaire. The next section addresses the first main component of the research question - to what extent does the technology used for IOS provide flexibility.

6.4. Technological flexibility

The ability of information technology to provide flexibility was discussed in Chapter 2. In chapter 3 telecommunications, messaging standards and software, the three main components of IOS were outlined. Previous analysis of each of these technologies indicates that they can both provide and prohibit flexibility. This leads to the formulation of the first research question in chapter 4 - to what extent does the technology used for IOS provide flexibility. The survey seeks to answer this question by investigating whether organisations believe that the IOS technology is flexible. To this end the questionnaire gathered information on each of the main types of technologies for IOS. The next three subsections discuss the flexibility of the three main technological areas of IOS

6.4.1 Telecommunications method

In attempting to measure the degree to which IOS telecommunications methods provide flexibility several questions were asked. The importance of flexibility as a decision criteria when the telecommunications method was adopted was ascertained. In addition the extent to which problems arise due to the incompatibilities of network service providers is measured.

6.4.1.1 Decision criteria in choosing the telecommunications method

The survey sought to gauge the importance of technological flexibility as a decision criteria when the organisation chose their telecommunications method. Organisations were asked to rate the importance of six issues taken into consideration when they selected the telecommunications method for the IOS.

The most important consideration of the six offered is the ability to connect additional trading partners to the telecommunications infrastructure (Figure 6.13). The second most important criteria is the customer service record of the

telecommunications provider, which is ranked above the cost of the service. When deciding on which telecommunications method to use, the majority of the organisations (56%) do not consider the capability to change the telecommunications method in the future important.

Considerations when choosing the telecommunications method for the IOS	**Agree or Strongly Agree**	**Mean**
Ability to connect additional trading partners to the telecommunications infrastructure	71%	3.77
Customer service record of the telecommunications service provider	54%	3.42
Cost	55%	3.38
Ability to change telecommunications method if desired	44%	3.24
Trading partner(s) provided the technology and the required telecommunications method	44%	3.15
Other	3%	2.64

Figure 6.13: Considerations when choosing a telecommunications method for IOS

In order to ascertain if additional decision criteria may have influenced organisations when they chose the IOS telecommunications method an open ended question was included. Respondents were invited to specify other criteria that they felt were important. 89% provided no answer to this question. Of the 11% who did answer the question only 3% provided additional criteria. The other 8% believe that, for their organisation, no additional criteria existed. Thus, five organisations (3%) provided other criteria that were important in their decision when choosing a telecommunications method. The reasons given have to do with aspects of the customer service of the telecommunications provider. They include (i) the importance of choosing a service provider who understood the business, (ii) the nature of the service provided by the service provider and (iii) the simplicity of the service so as to enable smaller customers of the organisation to use the service.

6.4.1.2 Incompatibility of network service providers

Previous research has suggested that incompatibilities exist between different value added network services (VANS) (Janssens and Cuyvers, 1991; Fynes and Ennis, 1993). The survey investigates this by asking if the incompatibility of different network service providers has been problematic for organisations. 38% of respondents have experienced problems in this regard (Figure 6.14).

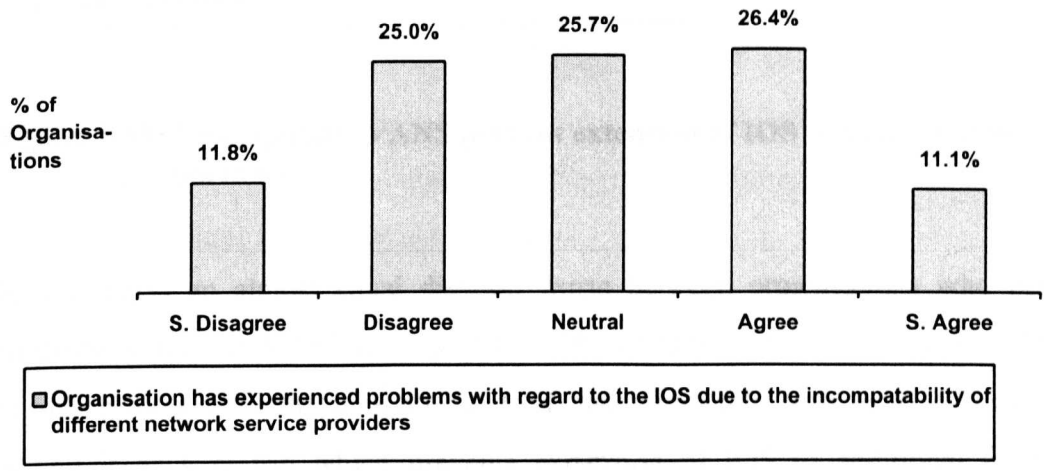


Figure 6.14: Problems due to the incompatibility of different network service providers

Further insight into the incompatibility of different network service providers was obtained by asking those organisations who are using IOS with only one type of trading partner whether such incompatibilities are a reason why they have not extended IOS usage to additional types of trading partners. Eighty eight organisations (59% of respondents) currently communicate with only one type of trading partner. The results show that non-compatibility of network service providers is not seen by most organisations as a reason which is preventing them connecting to additional types of trading partners. Ten percent of organisations agree or strongly agree that it is a reason for non expansion to additional types of trading partners (Figure 6.15).

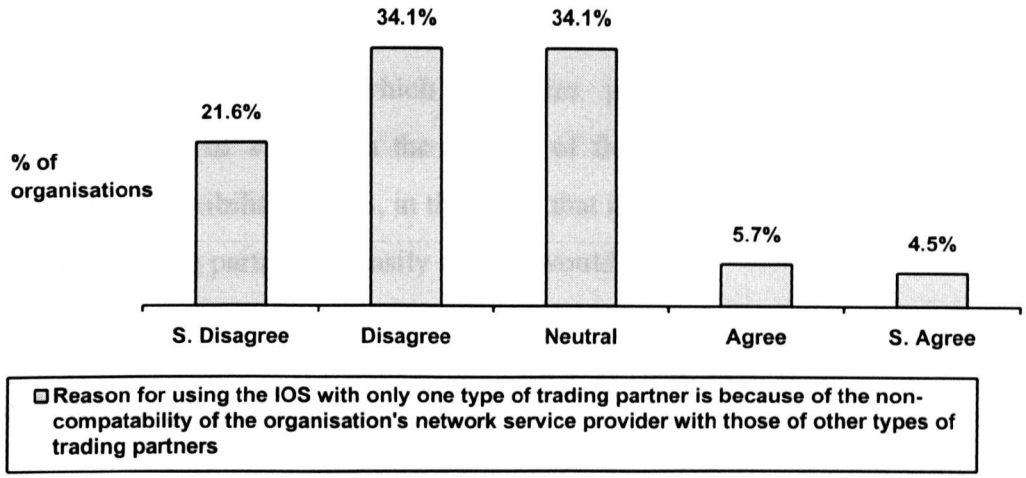


Figure 6.15: Incompatible VANS prevent extension of IOS to other trading partners

In summary, an almost equal division exists between organisations who believe incompatibilities in VANS are a problem (38%) and those who do not (37%). While it may pose a difficulty it is not in itself insurmountable with only 10% of firms giving it as a reason which prevents expansion of IOS to additional forms of companies. However, the reason that a large percentage (56%) of organisations trading with only one type of trading partner do not perceive such a problem, may be in large part due to them not having tried to extend IOS usage to additional types of trading partners. Thus by not expanding they have not encountered the difficulties.

6.4.1.3 Discussion

Organisations are conscious of flexibility at the time they make their decision as to which telecommunications method to use. In particular the ability to extend the usage of IOS to additional firms is perceived to be very important. Also firms desire to possess the propensity to be able to change the telecommunications method if required. Both of these traits show that organisations seek adaptability when picking the telecommunications method.

The survey demonstrates support for previous research (Janssens and Cuyvers, 1991; Fynes and Ennis, 1993) which identifies problems with IOS due to the incompatibilities of VANS. In the context of flexibility this difficulty reduces the technological flexibility of IOS, in the sense that it prohibits organisations connecting additional trading partners as easily as they would wish.

6.4.2. Messaging standards

Open messaging standards are the most common type of standard being used, with seventy eight percent indicating that they use such standards (Figure 6.16). Other standards in use include in-house proprietary messaging standards and standards which are provided by trading partners.

Messaging standard used to exchange IOS messages	**Number of organisations**
Open messaging standard e.g. EDIFACT, ANSI X12, X400, X435, HTML	**118 (78%)**
In-house proprietary messaging standard	**18 (12%)**
Messaging standard of trading partner	**18 (12%)**

Figure 6.16: Messaging standard used

In order to investigate if the attainment of technological flexibility was perceived to be consequential the criteria used in deciding on which messaging standards to adopt initially were studied. In addition the survey sought to ascertain the extent to which organisations believe that messaging standards are adaptable.

6.4.2.1 Decision criteria in choosing IOS messaging standards

Organisations were asked to rate the importance of five considerations when deciding on the messaging standard for IOS (Figure 6.17). For 70% of firms the messaging standard was chosen for them by their trading partner. In such cases organisations adapted the selected standard. The availability of an open non-proprietary messaging standard influenced 47% of organisations in their decision, while 21% believe it had

no influence. The ability to subsequently change the format of IOS messages was an important consideration for 33% of organisations, however 27% felt it unimportant. Cost savings influenced the decision of 30% of organisations. In contrast 34% believe that considerations of economic savings were not an important consideration.

Important influence when choosing the messaging standard	Agree or Strongly Agree	Mean
Trading partner(s) had already decided, and your organisation followed their decision	70%	3.80
The availability of an open non-proprietary messaging standard	47%	3.34
Ability to subsequently change the format of the IOS messages	33%	2.99
Cost Savings	30%	2.85
Other please specify	3%	2.62

Figure 6.17: Important influences when choosing the messaging standard

Other important decision criteria in choosing a messaging standard which have not been highlighted in the literature were solicited. Only five respondents offered additional criteria which were important when choosing the messaging standard. These reasons include a nationally endorsed standard, a widely used international standard, a need to provide better customer service, a need for accuracy and a requirement to follow group policy.

6.4.3.2 Adaptability of messaging standards

The existence of different messaging standards prevents organisations from incorporating other types of trading partners into IOS usage (Edwards, 1987; Janssens and Cuyvers, 1991; Horluck, 1994). In this survey the majority of organisations, (89%), who have not expanded the use of IOS to additional types of trading partners do not believe that the non-compatibility of messaging standards is preventing such expansion (Figure 6.18). Only 11% of the eighty seven organisations who currently trade with a single organisational type believe that the non-

compatibility of messaging standards impedes them from expanding IOS to include additional organisational classifications.

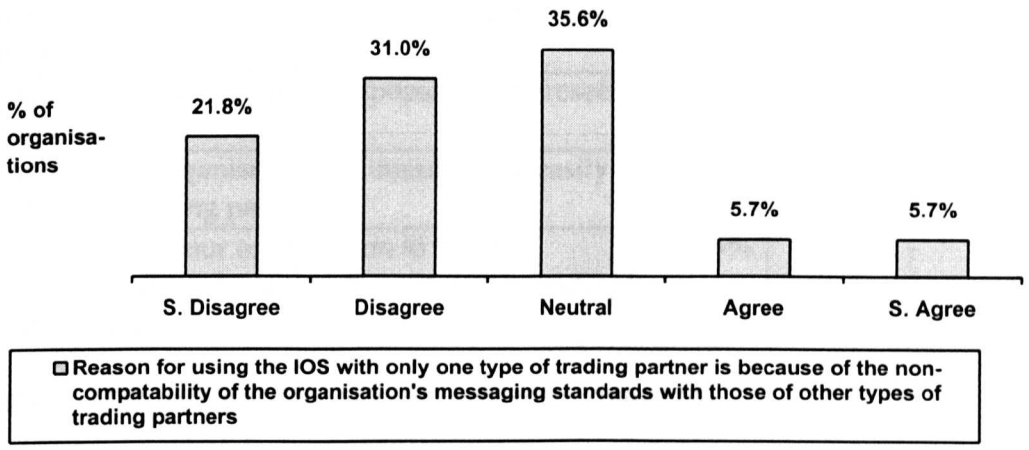


Figure 6.18: Non-compatibility of messaging standards preventing IOS expansion

Specific measures of the technological flexibility of messaging standards are obtained in the survey (Figure 6.19). Sixty nine percent of organisations believe that IOS messaging standards enable them to communicate easily with their trading partners and 65% believe that IOS messaging standards will allow them to begin communicating electronically with a new trading partner easily. Only 10% perceive IOS messaging standards as not enabling easy communication, and 14% think that IOS messaging standards do not facilitate simple connection of new trading partners to the network.

Brousseau (1994) argues that one of the key assumptions behind messaging standards is the capability to operate within foreseen domains. The flexibility of the messaging standards in specific circumstances is tested in this survey. This is done by asking if the standards are, first adaptable and, second, if they can be changed rapidly in response to unforeseen circumstances (Figure 6.19). Twenty one percent of respondents believe that messaging standards are not adaptable. The inability to change with respect to unforeseen circumstances is more marked, with only 20% believing that the messaging standards can change, while 43% believe they cannot.

IOS messaging standards	Agree or S. Agree	Neutral	Disagree or S. Disagree
are adaptable	45%	34%	21%
reduce the ability of organisations to adopt new business processes	6%	32%	62%
can be changed rapidly in response to unforeseen circumstances	20%	37%	43%
enable your organisation to communicate easily with your trading partners	69%	21%	10%
usage allows your organisation to begin communicating electronically with a new trading partner easily	65%	21%	14%

Figure 6.19: Adaptability of IOS messaging standards

These findings however must be balanced against only 6% of organisations believing that IOS messaging standards reduce the ability to adopt new business processes. The majority, 62%, believe that standards have no such effect. In addition, 65% of organisations believe that currently used standards allow them to begin communicating electronically with a new trading partner easily.

6.4.2.3 Discussion

The fact that the majority of organisations adopt the messaging standard proposed by their trading partner indicates that these organisations are unable to make an independent decision. However, this finding needs to be offset against the fact that 78% of organisations use open non-proprietary messaging standards. Hence in most cases trading partners appear to be requesting that firms adopt non-proprietary standards. The availability of such open messaging standards is viewed as important by organisations. These findings indicate that organisations do view the flexibility of messaging standards in terms of the ability to connect additional firms to IOS as worthy of consideration. For the majority of organisations the messaging standards are providing the flexibility desired. Specifically, they facilitate easy communication with trading partners and allow additional trading partners to be added easily. As

such the standards are providing flexibility with regard to 'foreseen' or expected circumstances (Brousseau, 1994; Galliers et al., 1995).

For the majority of organisations however messaging standards are not seen as flexible in the sense of being able to respond rapidly to unforeseen circumstances. In addition 21% perceive messaging standards to be inflexible in terms of adaptability. However, contrary to Galliers et al. (1995), the vast majority do not believe that messaging standards cause inflexibility in terms of impeding changes to business processes if required. A possible reason for problems with adapting messaging standards may be that it is not an important decision criteria when choosing which standard to adopt. The majority (67%) were indifferent to the ability to subsequently change the format of IOS messages at the time they made a decision to use them.

In deciding on a messaging standard organisations consider certain aspects of flexibility but overlook others. Specifically they require the flexibility to be able to connect other firms to the IOS but are unconcerned that the inability to change the format of messages may prove constraining. As such organisations appear to be concerned with maintaining versatility, or foreseeable flexibility, while overlooking robustness, unforeseeable flexibility.

6.4.3 Software

The third technological component of IOS is the software which runs the systems. Organisations were asked if they experienced problems due to a lack of IOS software. Twenty percent of organisations believe that the lack of IOS software has been a cause of problems for them in the past (Figure 6.20). Forty five percent however did not experience problems with the IOS software they chose.

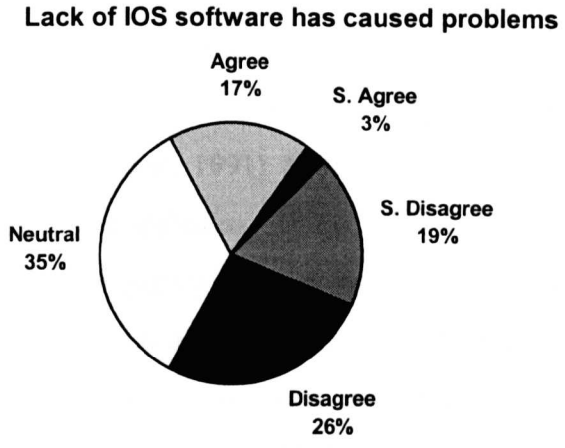


Figure 6.20: Lack of IOS software has caused problems

In addition to assessing the level of satisfaction with the IOS software, the survey also sought to measure the extent to which organisations have experienced problems due to incompatibilities between the IOS software and other software within the organisation (Figure 6.21). The difficulties being caused by the lack of software compatibility between the IOS software and the IS software are considerable. Forty two percent of the organisations studied experienced problems due to the integration of their IOS software with their existing information systems.

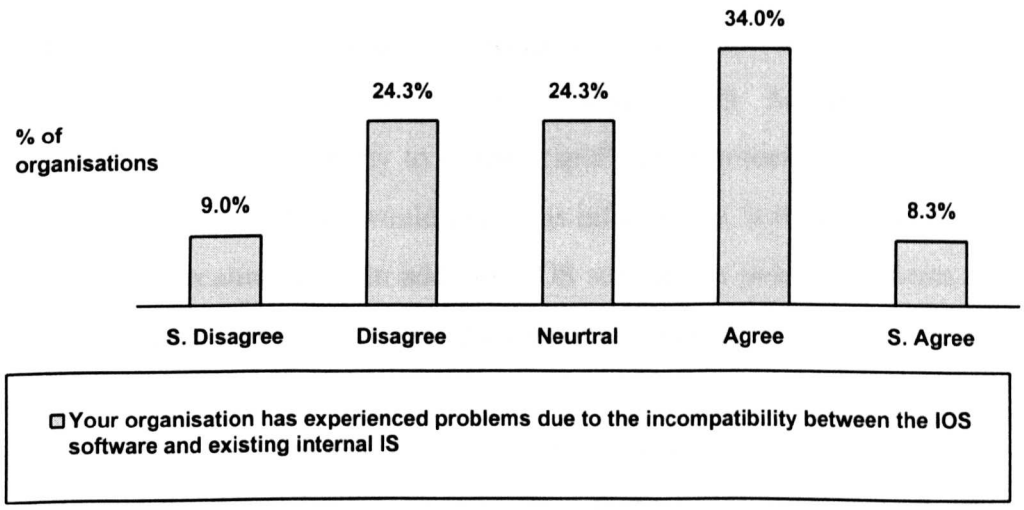


Figure 6.21: Problems experienced with IOS software integration

The existence of incompatibilities between the IS and IOS software has been identified in previous studies (Swatman and Swatman, 1991; Mackay, 1993). Integration is desirable as it is required if organisations are to gain the maximum benefit from IOS (Baker, 1991) Normally what impedes the integration of both systems is costs (Emmelhainz, 1990). The costs incurred usually comprise of programming time in getting the two systems to communicate seamlessly with one another. Inherent in this programming is the fact that the integration of IOS with existing systems was never foreseen. As such the systems lack the technological flexibility to incorporate the required changes.

6.4.4 Discussion

The survey shows that there are areas where the technology used for IOS provides flexibility and circumstances where it does not. Specifically, IOS technology enables flexibility for foreseeable circumstances, such as adding new trading partners and enabling fast communication. However, with respect to unforeseen circumstances the technology is not believed to be flexible.

The specific technologies required to run IOS reduce flexibility in certain respects. Telecommunications methods, specifically VANS, are inflexible in that incompatibilities exist between the different VANS. Messaging standards are inflexible in that their ability to change rapidly in foreseen circumstances is not as fast as some organisations would like. This inflexibility is more notable in respect of unforeseen circumstances. In addition, IOS software is posing problems in that it is not easily integratable with existing information systems.

In conclusion, the research shows that problems exist with the technology which render it inflexible in certain respects. This finding is in keeping with other studies (Lucas and Olson, 1994; Suarez et al., 1995) which show that the technology itself can constrain an organisation's ability to react and change to new circumstances.

Having examined the extent to which the IOS technology provides flexibility the next section assesses the degree to which the use of IOS provides flexibility.

6.5 Organisational flexibility

The second research question in the study seeks to ascertain the extent to which the usage of IOS provides flexibility. This section presents the findings of the survey which answer this question. Given the exploratory nature of the research, the possibility that IOS could have a negative impact on an organisation's ability to adapt could not be eliminated. In order to explore this possibility organisations were asked if they believe that IOS will restrict their organisation's ability to adapt to changing business requirements in the future. Only 3% believe that it will, while 80% believe it will not and 17% do not know (Figure 6.22). This result provides a clear indication that IOS will not constrain the ability of an organisation to adapt.

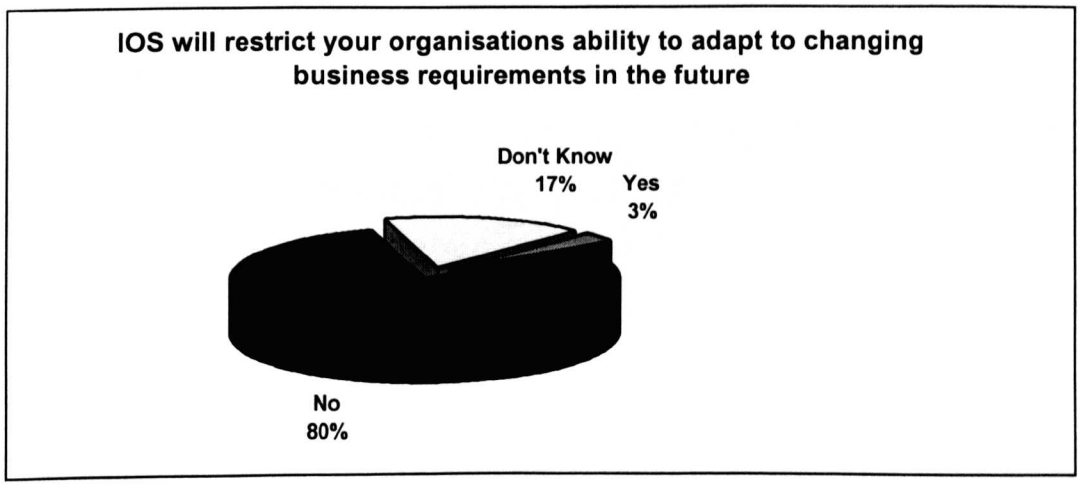


Figure 6.22: IOS restrict ability to adapt in the future

In assessing the extent to which using IOS provides flexibility 33 questions were asked which operationalise the temporal, range and focus dimensions of flexibility. The fourth dimension, intention, was operationalised by asking specifically whether the organisation had initiated the use of IOS or not.

The 33 questions on how IOS affect flexibility are obtained from the operationalisation of efficiency, responsiveness, versatility and robustness derived in chapter 3. Each of the questions was asked on a Likert scale of 1 to 5 with a response of 1 indicating that the respondent strongly disagrees that IOS provide a particular trait of flexibility and 5 indicating that they strongly agree that it does provide that trait of flexibility.

Individual questions of the 33 posed relate to one of the four metrics of flexibility. The questions associated with each specific metric are combined together to obtain overall measures for efficiency, responsiveness, versatility and robustness. In addition, the 33 questions are divided into two classifications on the basis of whether the effect of IOS is internal or external as depicted in chapter 3. Finally, a combined measure of all 33 questions is calculated to provide an overall measure of the extent to which individual organisations perceive themselves to be gaining flexibility from IOS.

Obtaining a single score for each organisation regarding each sub-set of flexibility questions was achieved by combining the specific questions and getting their overall mean. Any value over 3 indicates that organisations believe they are gaining organisational flexibility from IOS. The closer the value is to 5, the higher the degree of flexibility organisations believe they are deriving from IOS.

In order to verify the predictive power of the metrics of flexibility, which this study created, it was compared with the question which sought to ascertain whether organisations believe that IOS restrict their ability to adapt. Given that only 3% answered yes these are combined with the 17% who did not know. This action is taken to create a group of sufficient size to aid comparison. A significant relationship is found to exist between all of the measures of flexibility in this study and the belief that IOS will not restrict an organisation's ability to adapt in the future. The direction of the relationship is such that those who

believe that IOS will not restrict an organisation's adaptability give IOS a higher flexibility rating. This provides evidence that the measures of flexibility are accurate indicators of an organisation's beliefs.

6.5.1 Factor analysis

A principal components analysis (varimax rotation) was made to determine the number and nature of the factors or dimensions (Kerlinger, 1986), to be found in the 33 questions which comprise the 'flexibility' construct. For the purpose of this research it provides a way of measuring the accuracy of the four *a priori* factors of flexibility adopted in this study. This method has been used previously by Bergeron and Raymond (1992) in the study of EDI. Specifically their study seeks to obtain the principle components of EDI advantages from 21 questions.

In this study a six-factor structure is found, explaining 60.3% of the variance. The six categories of flexibility found by the factor analysis are outlined in Figure 6.23. A detailed breakdown as to which of the 33 questions operationalising flexibility is attributable to each individual factor is provided in Appendix 5.

Factor	Eigenvalue	% of Variance	Cumulative %
1. Inventory management	9.03	27.4%	27.4%
2. Organisational adaptability	5.34	16.2%	43.6%
3. Market management	1.84	5.6%	49.1%
4. Trading relations	1.35	4.1%	53.2%
5. Internal data costs	1.19	3.6%	56.8%
6. Information provision	1.14	3.4%	60.3%

Figure 6.23: Factor analysis of flexibility measures

The first category, which is named 'inventory management', relates to the impact of IOS on out-of-stock occurrences, the flexibility of the buying strategy,

inventory costs and the control an organisation has on the transport and distribution of goods.

A second category, 'organisational adaptability', refers to the effect IOS have on the ability of organisations to change. Specifically the capability to adapt to trading partner requests, business requirements, unforeseen circumstances and the ability to change trading partners if required.

A third factor, 'market management' concerns IOS influence on enabling organisations to be innovative in the marketplace. In particular, the ability of organisations to be more responsive, offer a wider product range, diversify into new markets, reposition themselves in existing markets and gain a competitive advantage.

A fourth category, 'trading relations' relates to the capability of IOS to alter the way in which organisations do business with each other. The factor refers to lead times, levels of service, document transmission costs, accuracy of the data being transmitted and closer associations with trading partners.

A fifth category, 'internal data costs' concerns the influence of IOS on data re-entry costs, labour costs and the time it takes to transmit documents. A sixth category, 'information provision' refers the capability of IOS to improve the quality of the information available within an organisation.

The factor analysis provides broad support regarding the validity of the four *a priori* flexibility metrics, efficiency, responsiveness, versatility and robustness. The evidence for this is shown because the individual questions for each of the four metrics are to a large extent grouped within specific factors (Appendix 5). The first factor comprises four questions all of which are efficiency metrics. The second factor, organisational adaptability, is made up of nine questions five of which relate to robustness. This factor, therefore, contains five of the eight operationalised measures of robustness. The third factor, market management

includes seven questions four of which are measures of versatility. This factor accounts for four of the five questions used in this study to assess versatility. Factor four is made up of seven questions, three each relating to responsiveness and efficiency and one to robustness. Factors five and six each contain three questions two regarding efficiency and one on responsiveness.

Therefore, four of the factors, inventory management, trading relations, internal data costs and information provision are derived predominantly from efficiency and responsiveness measures. Organisational adaptability is in large part a measure of robustness, while market management is centred around versatility. As such the factor analysis validates the a priori metrics of flexibility. These will now be discussed by relating them to the dimensions of flexibility.

6.5.2 Temporal dimension of flexibility

The temporal dimension of flexibility is operationalised by the two metrics efficiency and responsiveness. Twelve individual questions on efficiency were combined to obtain the overall measure. Sixty three percent of organisations believe IOS provide increased flexibility in the form of efficiency. In assessing responsiveness, eight individual questions were combined to provide the complete measure. 88% of organisations have an overall mean greater than 3, indicating that they are achieving flexibility with IOS in the form of increased responsiveness.

6.5.3 Range dimension of flexibility

The range dimension of flexibility is operationalised by the two metrics versatility and robustness. The five questions on versatility were combined to give an overall measure. 43% of organisations have an overall mean score greater than 3 for the combined versatility measure. This shows that for the majority of organisations IOS are not providing additional levels of versatility. However, 27% have no opinion on

the matter and, thus, only 31% of organisations believe that IOS actually reduce the level of organisational versatility.

For the second metric of the range dimension, robustness, eight questions were amalgamated to give a combined measure. IOS are providing increased robustness for 85% of organisations.

6.5.4 Focus dimension of flexibility

The focus dimension of flexibility advocates that organisations can obtain flexibility both internally and externally. In order to obtain a metric of the level of flexibility being attained by an organisation internally, 18 questions which refer to internal processes are extracted from the 33 questions which sought to measure flexibility. 75% of firms scored a mean value greater than 3, indicating that they believe IOS contribute to flexibility within organisations.

The second component of the focus dimension is the degree to which IOS provide additional external flexibility between organisations who use IOS to trade with each other. A metric for this is obtained by extracting and combining the 15 questions relating to external flexibility measures. 80% of organisations believe that IOS are having a positive effect on the level of flexibility between them and their trading partners.

6.5.5 Combined measure of flexibility

An overall measure of the effect that IOS is having on flexibility is obtained by combining the 33 individual questions on flexibility. Eighty one percent of organisations believe that, on the overall measure of flexibility, IOS have a positive effect on the level of organisational flexibility being achieved.

6.5.6 Discussion

For each measure of flexibility, with the exception of versatility, the majority of organisations are obtaining increased levels of flexibility from IOS (Figure 6.24). The combined measure of flexibility which incorporates 33 questions indicates that over 80% of organisations are gaining flexibility as a result of using IOS. Therefore, on the basis of the combined and individual measures of flexibility derived for the purpose of this exploratory study, it is shown that IOS do provide organisations with improved levels of flexibility.

With respect to the focus dimension of flexibility it can be concluded that the majority of organisations are achieving increased flexibility from IOS both internally and externally. The fact that increased flexibility is being achieved externally is explained by the fact that the basis of IOS is to enable external links. At an exploratory level it is possible to determine that organisations are achieving marginally more flexibility externally than internally. Evidence for this appears in that 80% believe they gain external flexibility whereas 75% believe that they gain internal flexibility. A further indication can be obtained by looking at the quartile percentages (Figure 6.24). At each quartile the score for external flexibility is higher than the equivalent one for internal flexibility. Hence, in general, IOS are providing organisations with relatively higher levels of external flexibility than internal flexibility.

Combined Flexibility Measures	**% of organisations with an overall mean > 3**	**25% Quartile**	**50% Quartile**	**75% Quartile**
Efficiency	63%	2.917	3.167	3.417
Responsiveness	88%	3.250	3.500	3.750
Versatility	43%	2.800	3.000	3.400
Robustness	85%	3.143	3.429	3.714
Internal Flexibility	75%	3.000	3.222	3.458
External Flexibility	80%	3.067	3.367	3.600
Total Flexibility	81%	3.091	3.303	3.545

Figure 6.24: Combined flexibility measures

Firms using IOS gain divergent levels of flexibility in terms of efficiency, responsiveness, versatility and robustness. In addition organisations differ with respect to the extent to which they obtain flexibility both internally and externally from IOS. This deviation with respect to each of the flexibility measures indicates that organisations differ with respect to the level of flexibility they obtain from IOS. Evidence for the fact that organisations differ with respect to how they use IOS to achieve flexibility is shown in Figure 6.24 by examining the quartile figures. These show that organisations score differently with respect to the flexibility metrics used in this study. This finding provides grounds to investigate the third research question in this study which is; what organisational factors influence the variation in the degree of flexibility being achieved by different IOS participants? This section has found that organisations do vary with respect to the degree of flexibility being achieved from IOS and hence shows that the third research question is valid.

6.6 Organisational factors

The intent of the third research question is to investigate what organisational factors influence the variation in the degree of flexibility being achieved by different organisations. Chapter 3 outlines previous studies which identify organisational factors that are significant in explaining differences in the levels of benefits being obtained from IOS. This study proposes that since flexibility is a benefit of IOS, the same organisational factors might explain differences in the degree of flexibility being achieved.

In researching this question this section takes the measures of flexibility outlined and verified in the previous section and uses them as metrics against which to compare organisational traits and characteristics. The factors being investigated are (i) organisational size, (ii) whether or not the organisation initiated IOS, (iii) the intention of the organisation when setting up IOS, (iv) the degree of IT expertise within the organisation, (v) the degree of integration between the IOS

plan and both the IS and business plans, (vi) the degree of IOS integration within the firm, (vii) the rate of change in the firm's markets, and (viii) the length of time using IOS.

6.6.1 Organisational size

Larger organisations can often gain more benefits from IOS relative to smaller ones (Webster, 1995). In a similar way this research proposes that a relationship might exist between the size of the organisation and the degree of organisational flexibility which IOS provide. To test this proposition the measures of flexibility obtained are compared with two measures of organisational size; annual turnover and employee numbers. No significant relationship is found to exist between any of the measures of flexibility and either annual turnover or the number of employees.

This finding indicates that organisational size is not a determinant of the degree of flexibility achievable from IOS. This provides encouragement for smaller organisations as it indicates that neither the annual turnover nor the number of employees is a good indicator of the level of flexibility that is attainable from IOS.

6.6.2 Initiating organisations / non-initiating organisations

Important distinctions exist between organisations who initiate IOS and those who do not (Chismar and Meier, 1992). Recognising this the research poses an exploratory proposition that those organisations who initiate IOS achieve more organisational flexibility relative to non-initiating organisations. In order to test this proposition respondents were asked whether their organisation had initiated the adoption of IOS. Sixty six organisations representing 45% of respondents were initiators of IOS (Figure 6.25). Seventy five organisations, (52%) were not initiators of IOS and the remaining 4 organisations, (3%) did not know whether

their organisation initiated IOS or not. For the purpose of further analysis these 4 organisations were eliminated.

	Yes	No	Don't Know
Organisation initiated the adoption of IOS	66	75	4

Figure 6.25: Initiating organisations / non-initiating organisations

A significant difference exists between the degree of organisational flexibility being gained by those who initiate IOS and those who do not. The difference is significant for all of the measures of flexibility (Figure 6.26). The results indicate that those organisations who initiate IOS achieve significantly greater organisational flexibility than those who do not.

Description	Mann-Whitney U	Lambda
Efficiency	.0004	.28125
Responsiveness	.0001	.31818
Versatility	.0000	.30303
Robustness	.0016	.29231
Internal Flexibility	.0000	.39394
External Flexibility	.0012	.33333
Total Flexibility	.0000	.5000

Figure 6.26: Initiator / non-initiator of IOS

The results in Figure 6.26 show that a significant difference exists between the two groups of organisations, initiators and non-initiators, with initiators achieving higher levels of organisational flexibility relative to non-initiators. The higher levels of flexibility are significant internally, externally and across the constituents of flexibility; efficiency, responsiveness, versatility, and robustness.

Further evidence of the existence of differences between initiators and followers is provided by re-analysing the initial reason for adopting IOS on the basis of the initiator / non-initiator classification. The reasons for adopting IOS differ significantly depending on whether or not the organisation initiates the system (Figure 6.27). For initiators, a desire to speed up information provision, followed

by a desire to improve customer service are most important. However, for non-initiators, unsurprisingly, the overwhelming reason for adopting IOS is because they were requested to do so by a trading partner.

Reason for adopting IOS 1 = to strongly disagree 5 = strongly agree	Rank and mean of all responding organisations	Mean of initiating organisa-tion	Mean of non-initiating organisa-tion	Significance of difference between means (Mann-Whitney U test)
improve level of customer service	1 4.12	2 4.15	2 4.11	
speed information transmission	2 3.95	1 4.17	4 3.70	.0196
requested by trading partner	3 3.73	9 2.75	1 4.56	.0000
improve productivity	4 3.69	3 4.05	7 3.29	.0000
keep up with competitors	5 3.61	7 3.48	3 3.74	
increase the accuracy of data	6 3.56	5 3.75	5 3.37	
gain competitive advantage	7 3.55	4 3.80	6 3.30	.0097
decrease costs	8 3.08	6 3.49	10 2.65	.0001
facilitate better cash management	9 3.04	8 3.32	8 2.79	.0187
increase sales	10 2.69	10 2.70	9 2.68	
enable greater product range	11 2.45	11 2.60	11 2.31	

Figure 6.27: Reasons for initially adopting IOS

The existence of a difference between initiators and non-initiators is further proven by examining whether any variance exists in how fairly they believe the benefits of IOS are shared between trading partners. A significant difference is found between the two groups as regards their beliefs that the benefits are shared equally (Figure 6.28). Those who initiated IOS are significantly more likely to say that the benefits are being shared equally, while those requested to adopt IOS are significantly more likely to say that the benefits are not equally distributed.

Initiator / non initiator	**Mann-Whitney U**	**Lambda**
Benefits shared equally between trading partners	.0009	.15385

Figure 6.28: Initiator / non-initiator: Degree to which benefits are shared equally

The statistically significant differing viewpoints between initiators and non-initiators on several variables shows that differences exist between the two

groups. Further, it has been shown that a statistically significant difference exists between the two groups with regard to the level of organisational flexibility being acquired from IOS. It can be further concluded that initiators achieve higher levels of flexibility relative to non-initiators.

6.6.3 Initial reason for adopting IOS

Organisations who adopt IOS as part of their organisational strategy tend to gain more benefits (Swatman et al., 1994), while organisations who do so at the request of a trading partner receive less benefits (Hwang, 1991). This research proposes that a possible explanation for the differing degrees of flexibility between organisations might be the goals an organisation sets for itself when adopting IOS. In order to test if this is the case, two of the reasons for initially adopting IOS are compared with the measures of flexibility obtained. The two reasons selected, (i) to gain a competitive advantage and (ii) because an organisation was requested to do so by a trading partner, were chosen as they typified the difference between an offensive and a defensive adoption of IOS.

6.6.3.1 To gain a competitive advantage

Organisations were asked the extent to which they had adopted IOS in order to gain a competitive advantage (Figure 6.29). The majority of organisations, 54%, adopted IOS in order to gain a competitive advantage. Fifteen percent, however, were not actively seeking a competitive advantage when they started using IOS. While the achievement of competitive advantage was a major reason in adopting IOS, it should be noted that 60% of organisations also indicated a need to keep up with competitors as one of the reasons for adoption.

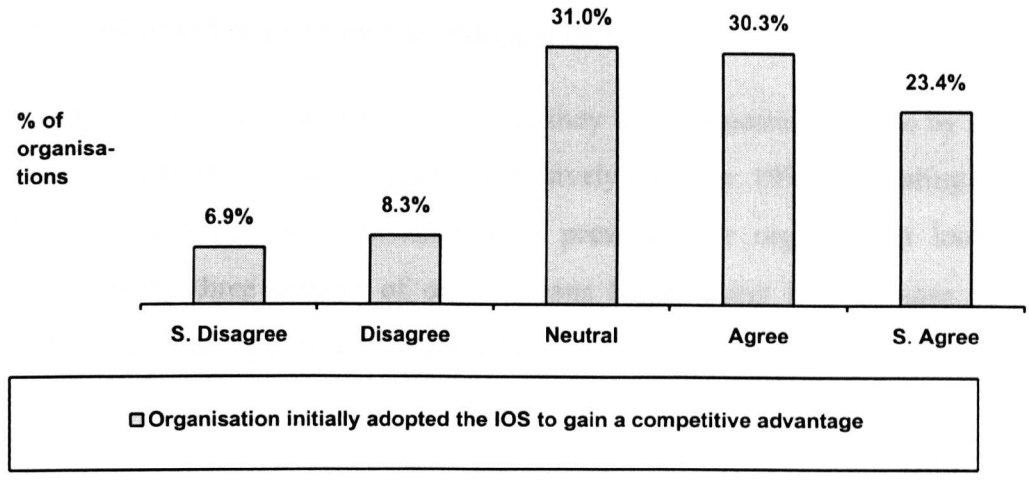


Figure 6.29: Initially adopted IOS to gain a competitive advantage

The degree to which organisations did or did not seek a competitive advantage from IOS was compared with the different metrics of flexibility. The comparison yields statistically significant differences for each metric of flexibility (Figure 6.30). The measure of association is positive for each metric, indicating that the degree to which organisations sought competitive advantage provides a good measure of the degree of flexibility they subsequently achieve from IOS. Thus organisations adopting IOS in an offensive manner are more likely to gain organisational flexibility from IOS. The next section deals with organisations who initially adopt IOS in a defensive way.

Adopted IOS to gain a competitive advantage	Significance Level (Spearman's Rho)	Measure of Association (Spearman's Rho)
Efficiency	.001	.2661
Responsiveness	.004	.2376
Versatility	.000	.4593
Robustness	.008	.2207
Internal Flexibility	.000	.3001
External Flexibility	.002	.2518
Total Flexibility	.000	.3715

Figure 6.30: Intention when adopting IOS: For competitive advantage

6.6.3.2 Requested to do so by a trading partner

Organisations who start to use IOS because they were requested to do so by their trading partners are essentially acting defensively (Hwang, 1991). Adopting IOS technology is a defensive mechanism to prevent their organisation loosing business. Sixty three percent of organisations began using IOS because of a request from a trading partner (Figure 6.31).

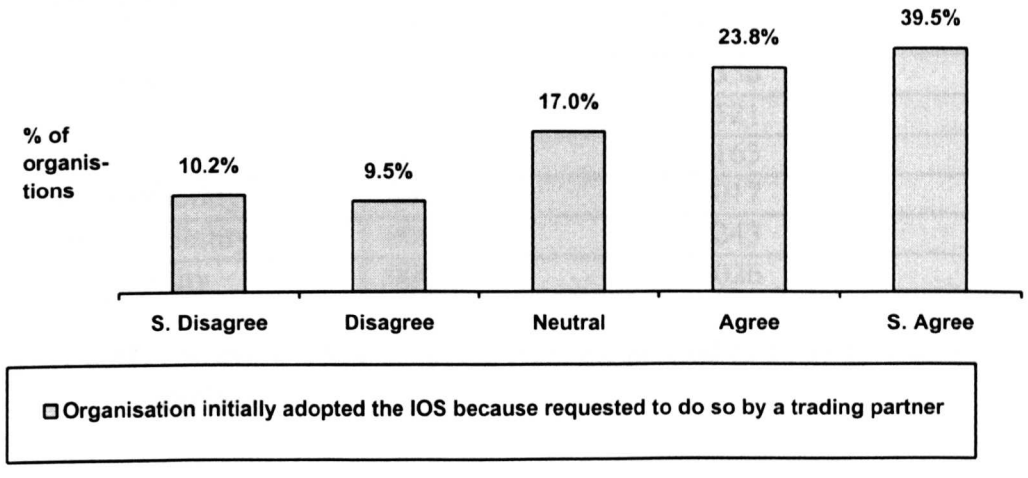


Figure 6.31: Reason for adopting IOS: Because requested to do so by trading partner

The degree to which organisations adopted IOS in response to a request from a trading partner proves to be a good indicator of the level of flexibility subsequently being achieved from IOS. A significant relationship is found between each of the metrics of flexibility and the degree to which organisations believe they had to adopt IOS as a result of requests from trading partners (Figure 6.32). For each measure of flexibility a negative relationship was found to exist. This indicates that the more a belief exists within an organisation that it was forced to adopt IOS by a trading partner, the less flexibility it gains from IOS.

This section demonstrates that the initial reasons for adopting IOS have direct effects on the levels of organisational flexibility subsequently achieved from IOS. Those organisations who use IOS as offensive weapons, in the sense of providing

competitive advantage, gain relatively more organisational flexibility. The corollary to this is also true - those organisations who adopt IOS for defensive reasons, in particular because they are requested to do so by other firms, gain relatively less organisational flexibility.

Adopted IOS because requested to do so by trading partner	Significance Level (Spearman's Rho)	Measure of Association (Spearman's Rho)
Efficiency	.001	-.2714
Responsiveness	.004	-.2356
Versatility	.002	-.2521
Robustness	.009	-.2163
Internal Flexibility	.000	-.3017
External Flexibility	.006	-.2243
Total Flexibility	.000	-.3026

Figure 6.32: Intention when adopting IOS: Requested to do so by trading partner

6.6.4 Integration of the IOS plan with other plans

The next two sections explore the possibility that organisations who integrate the IOS plan with other organisational plans achieve higher levels of organisational flexibility. The survey obtained measures of the level of integration between the IOS plan and both the IS and business plans. The purpose of this is to see if the level of organisational flexibility being provided by IOS is affected by the degree of integration between the IOS plan and either the IS plan or the business plan.

6.6.4.1 IS plan

If the full potential of IOS is to be achieved then the IS and the IOS plans need to be integrated (Cox and Ghoneim, 1994). The degree to which the IOS plan is associated with the information systems plan is assessed in the survey and 33% of organisations have a low level of association between the two plans (Figure 6.33). Thirty two

percent of organisations have no opinion on the subject and 35% disagree that there is a low degree of integration between the two plans in their organisation.

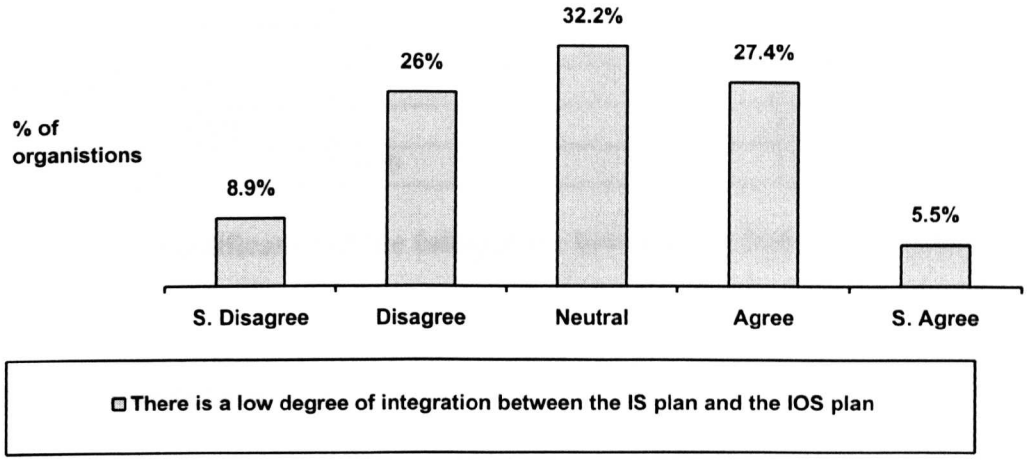


Figure 6.33: Degree of integration between the IS plan and the IOS plan

The degree of association between the IOS plan and the IS plan is contrasted with the measures of flexibility. A significant difference is found between the degree of integration of the two plans and the combined measure of flexibility (Figure 6.34). No significant differences exist between the degree of integration and either the measure of internal or external flexibility. However, significant differences exist between the degree of integration of the two plans and the flexibility measures of responsiveness, efficiency and robustness.

Given the wide dispersion in the sample size in terms of annual turnover it was felt important to see if any significant difference exists between the level of integration of the two information systems plans and an organisation's annual turnover. This was done because larger organisations have been found to be more proficient in IS planning. No significance was found, and it can be concluded that the finding was not biased by organisational size.

Integration between the IOS plan and IS plan	Significance Level (Spearman's Rho 1 tailed test)	Measure of Association (Spearman's Rho)
Efficiency	.039	-.1475
Responsiveness	.004	-.2177
Versatility	-	
Robustness	.029	-.1575
Internal Flexibility	-	
External Flexibility	-	
Total Flexibility	.039	-.1460

Figure 6.34: Significance of the integration between the IOS and IS plans

6.6.4.2 Business plan

The second type of planning integration measures the degree to which IOS planning is linked to the business plan. Organisations differed considerably in the extent to which links exist between the two plans. Thirty five percent have a high degree of integration between the IOS plan and the business plan. However 32% experience a low degree of integration between the two plans (Figure 6.35).

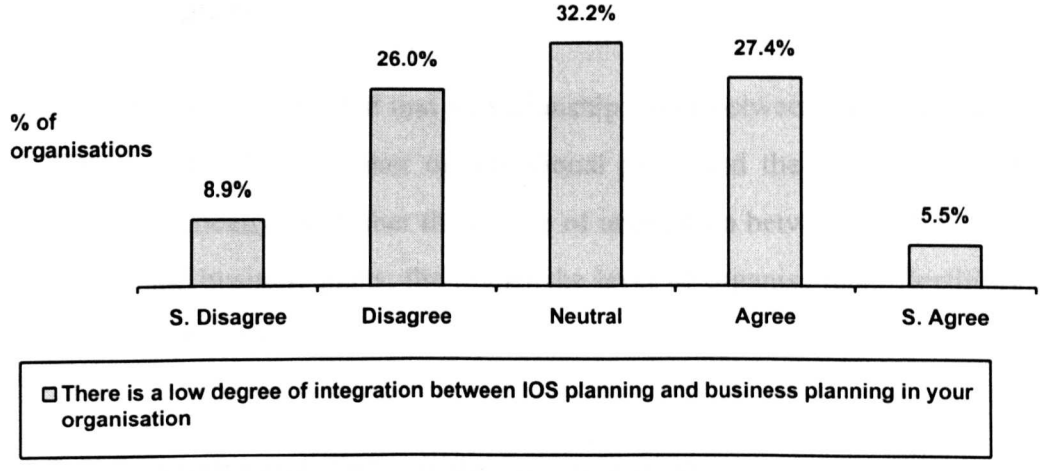


Figure 6.35: Degree of integration between the IOS plan and the business plan

The degree to which the IOS and the business plans are integrated has a significant relationship to the overall measure of flexibility (Figure 6.36). Significant relationships exist between the level of integration of the two plans and efficiency,

responsiveness, and versatility. The direction of the relationship between the level of integration being achieved between the two plans and the metrics of flexibility indicate that higher levels of flexibility exist with higher levels of planning integration. As with IS planning, the level of integration is compared to organisational size in terms of annual turnover and no significant relationship is found to exist. This indicates that no relationship exists between the size of the organisation and the level of integration being attained between the IS and the business plan.

Description	Degree of Significance (Spearman's Rho 1 tailed)	Measure of Association (Spearman's Rho 1 tailed)
Efficiency	.046	-.1418
Responsiveness	.005	-.2163
Versatility	.003	-.2310
Robustness		
Internal Flexibility		
External Flexibility		
Total Flexibility	.031	-.1545

Figure 6.36: Significance of the integration between the IOS and business plans

This section has demonstrated that a relationship exists between the degree to which the IOS plan is linked to other organisational plans and the degree of flexibility achieved. Specifically the higher the degree of integration between the IOS plan and both the IS and business plans, the higher the level of organisational flexibility that is obtainable from IOS.

6.6.5 IT Expertise existing within the organisation

It has been demonstrated in previous literature (Cavaye and Cragg, 1995; Iacovou et al., 1995) that higher levels of internal IT expertise enable organisations to obtain higher levels of benefits from their IS systems in general and IOS in particular. Three questions in the survey sought to investigate whether the level of internal IT expertise is related to the level of organisational flexibility achieved. These

questions asked (1) whether IT expertise within the organisation is better than in competing organisations, (2) whether IT expertise helped in the design of IOS and (3) whether IT expertise aided the implementation of IOS.

Previous organisational IT experience is seen by most organisations to be beneficial when IOS are being designed and implemented. Fifty three percent of respondents believe that previous IT experience helps with the designing of IOS, and 50% believe previous IT experience makes the implementation of IOS easier. A sizeable minority however, hold that previous IT experience within the organisation did not assist either the designing or implementation of IOS. Twenty four percent believe it did not help when designing IOS and 22% think it did not help at the implementation stage.

Of the respondents who express an opinion, 35% regard their organisations' IT expertise to be better that their competitors', while 12% believe that their expertise is worse than their competitors'. A significant relationship (Figure 6.37) exists between the level of flexibility being gained from IOS and the degree to which organisations hold that their IT expertise is better that their competitors'. The relationship also exists for both internal and external flexibility. The direction of the relationship demonstrates that higher levels of organisational flexibility from IOS correspond with superior ratings of internal IT expertise.

IT expertise is better than competitors	**Degree of Significance (Spearman's Rho 2 tailed)**	**Measure of Association (Spearman's Rho 2 tailed)**
Efficiency		
Responsiveness		
Versatility	.030	.1798
Robustness		
Internal Flexibility	.017	.1973
External Flexibility	.035	.1739
Total Flexibility	.035	.1740

Figure 6.37: IT Expertise in organisation better than competitors

The three individual measures of IT expertise are combined to give an overall measure. This aggregated measure of IT expertise is found to be significantly positively related to all of the metrics of flexibility except robustness (Figure 6.38). The fact that no relationship is found between IT expertise and robustness may relate to the fact that robustness is more of a business or management issue and is not directly affected by the IT expertise that exists within the organisation. In general, however, it can be concluded that higher levels of internal IT expertise correspond with the attainment of higher levels of organisational flexibility from IOS.

IT expertise within organisations	Degree of Significance (Spearman's Rho 2 tailed)	Measure of Association (Spearman's Rho 2 tailed)
Efficiency	.009	.2168
Responsiveness	.012	.2074
Versatility	.004	.2350
Robustness		
Internal Flexibility	.018	.1935
External Flexibility	.029	.1797
Total Flexibility	.005	.2284

Figure 6.38: Degree of IT expertise in existence when adopting IOS

6.6.6 Integration of IOS software with other internal IS

Previous research has found that the degree to which IOS software is integrated with existing IS software has a substantial impact on the levels of benefits achieved (Mackay, 1993; Cox and Ghoneim, 1994). This research sought to ascertain if the level of integration has an effect on one specific benefit, the level of organisational flexibility being attained. The findings support the proposition that the higher the degree of software integration achieved, the higher the level of organisational flexibility obtained. A significant relationship is found to exist between the degree of software integration and the level of flexibility achieved (Figure 6.39). The relationship exists for both internal and external flexibility. Of the four constituents of flexibility a significant relationship is found with both responsiveness and efficiency but is not found with versatility and robustness. The lack of a significant finding in both versatility and robustness may be

attributable to the fact that these are long term business traits over which software integration would have little influence.

Description	Significance Level (Spearman's Rho 2 tailed)	Measure of Association (Spearman's Rho 2 tailed)
Efficiency	.006	.2276
Responsiveness	.022	.1887
Versatility		
Robustness		
Internal Flexibility	.025	.1829
External Flexibility	.024	.1838
Total Flexibility	.006	.2237

Figure 6.39: Degree of IOS integration

The level of IOS software integration has been found to be significantly related to organisational size (Hwang, 1991) and the length of time IOS are in use (Premkumar et al., 1994). The survey found similar results, specifically, a significant relationship exists between the degree of software integration and organisational size measured both in terms of organisational turnover and the number of employees (Figure 6.40). The relationships are positive, indicating that larger organisation are significantly more likely to obtain a higher degree of software integration. The length of time that IOS are in use is found to be significantly positively related to degree of software integration.

Organisational Factors	Significance Level (Spearman's Rho 2 tailed)	Measure of Association (Spearman's Rho 2 tailed)
Employee Numbers	.032	.1771
Annual Turnover	.004	.2560
Years using IOS	.022	.1900

Figure 6.40: Relationship between IOS software integration and other organisational factors

In relation to planning, it is found that low levels of integration between the IS and IOS plans is significantly related to the degree of software integration. The relationship is such that organisations with higher levels of planning integration have higher levels of software integration. This result is to be expected as the integration of the two plans would in most cases prescribe a software integration strategy.

From the above it can be concluded that organisations who achieve higher levels of software integration between IOS and IS are more likely to obtain higher levels of organisational flexibility. The flexibility is gained in the form of increased efficiency and responsiveness. The attainment of higher levels of software integration are related to organisational size, longevity of IOS use, and the degree of integration between the IOS and IS plans.

6.6.7 External environment of organisations using IOS

Given that the reason for wanting flexibility is to respond to changes in one's environment, the survey sought to measure the degree to which a relationship exists between the turbulence of the external environment and the level of flexibility obtained from IOS. Respondents were asked to rate their opinions on five measures of how the external environment affected their firm. These measures are, (i) the degree to which a high degree of diversity in marketing and (ii) a high degree of diversity in production is required, (iii) the rapidity of changing customer tastes, (iv) the degree to which competitors' actions are highly unpredictable and (v) the degree to which the organisation operates in an environment of intense competition. These five measures are aggregated to provide a gauge as to the competitiveness of the external environment.

The intensity of the external environment is found to be significantly related to all of the metrics of flexibility (Figure 6.41). The relationship is found to be positive, indicating that a more turbulent external environment is significantly related to the degree of organisational flexibility being obtained from IOS.

External Environment	Degree of Significance (Spearman's Rho 2 tailed)	Measure of Association (Spearman's Rho 2 tailed)
Efficiency	.000	.2940
Responsiveness	.000	.2913
Versatility	.000	.3479
Robustness	.029	.1800
Internal Flexibility	.000	.3073
External Flexibility	.000	.2848
Total Flexibility	.000	..3346

Figure 6.41: External environment

Thus, organisations who compete in markets that are changing rapidly and in which a large amount of diversity is required are more likely to have IOS which provide increasing levels of organisational flexibility. This result indicates that organisations who operate in turbulent markets believe that IOS equate to higher levels of flexibility.

6.6.8 Longevity of IOS use

Another potential characteristic which could help explain differences in the levels of organisational flexibility obtained from IOS, is the length of time that IOS have been in use. The overall metric of flexibility is found to be significantly positively related to the longevity of IOS use (Figure 6.42). The increased flexibility comes predominantly in the form of internal flexibility, as external flexibility is not significantly related to longevity of IOS use. The increases in flexibility occur in responsiveness and efficiency.

6.6.9 Industry sector

The research also sought to ascertain whether certain industrial sectors gain more organisational flexibility relative to other sectors. No significant difference is

found to exist between the degree of flexibility being obtained from IOS and the industry sector in which organisations operate. From this it can be concluded that no sector is obtaining higher degrees of organisational flexibility from IOS relative to any other sector. Therefore the differences between the levels of organisational flexibility being achieved from IOS are not sector specific.

Longevity of IOS use	Degree of Significance (Spearman's Rho 2 tailed)	Measure of Association (Spearman's Rho 2 tailed)
Efficiency	.012	.2086
Responsiveness	.019	.1958
Versatility		
Robustness		
Internal Flexibility	.006	.2262
External Flexibility		
Total Flexibility	.011	.2092

(Note that time at either end of the question asked has been combined to provide 4 classes rather than 6)

Figure 6.42: Length of time using IOS

6.6.10 Discussion

In this section it has been established that certain characteristics of organisations are related to the degree of flexibility achieved from IOS (Figure 6.43). Organisations who initiate IOS obtain higher levels of flexibility relative to those who do not. The reason that IOS are initiated is also related to the level of flexibility subsequently achieved. Organisations who adopt IOS for reasons of competitive advantage obtain higher levels of flexibility. On the other hand, organisations whose primary reason for adopting IOS is in response to a trading partner request gain significantly lower levels of flexibility.

The degree of integration of the IOS plan with both the IS and business plans is positively associated with the degree of flexibility gained. Thus, the higher the level of integration between the plans the higher the degree of flexibility being

achieved from IOS. Organisations with higher levels of internal IT expertise gain relatively more flexibility from IOS. The degree of IOS integration with existing IS software is positively related to flexibility. Thus, organisations who fully integrate IOS into existing systems obtain higher levels of flexibility. The length of time that an organisation has been using IOS is positively related to flexibility. The major gains in flexibility over time are internal rather than external to the organisation. Organisations who operate in competitive environments are significantly more likely to gain higher levels of flexibility from IOS. On the other hand, traits such as organisational size and the sector in which an organisation operates are found to be unrelated to the extent of flexibility being gained from IOS.

Drivers of Flexibility	**Significance of relationship with overall metric of flexibility**		
	Internal	**External**	**Total**
Size of the organisation:			
Turnover	-	-	-
Employee Number	-	-	-
Initiator of IOS	.0000	.0012	.0000
Offensive intention when adopting IOS	.000	.002	.000
Defensive intention when adoption IOS	.000	.006	.000
Degree of integration between IOS plan and			
IS Plan	-	-	.039
Business Plan	-	-	.031
Degree of IT experience within the firm	.018	.029	.005
Degree of IOS integration within the firm	.025	.024	.006
External environment	.000	.000	.000
Longevity of IOS use	.006	-	.011
Sector in which company operates	-	-	-

Figure 6.43: Summary of organisational factors that effect flexibility

6.7 Conclusion

The research objective of this study is to examine the connection between IOS and flexibility. In particular, it seeks to investigate three research questions first, to what extent does the technology used for IOS provide flexibility, second, the

extent to which the use of IOS provide flexibility and third, what organisational factors influence the variation in the degree of flexibility being achieved by different IOS participants. The survey shown in this chapter presents the first part of the research which sought to answer these questions.

With respect to the first research objective organisations believe that certain aspects of IOS technology are not as flexible as they might be. Companies have experienced problems with telecommunications, in particular with Value Added Network Service providers not being easily interconnectable. This results in problems in connecting additional trading partners who currently operate on different VANS.

The majority of organisations believe that the second form of technology required, messaging standards, is flexible. They are flexible in the sense that they facilitate communication with connected firms and allow the connection of additional trading partners easily. A large percentage (45%) believe that the messaging standards are adaptable in foreseen circumstances. However, only 20% believe they can be adapted rapidly in response to unforeseen circumstances. Thus, messaging standards are, for the most part, flexible but are inflexible for unforeseen circumstances where a response is required in a short time frame.

The number of software packages currently on the market to manage the internal component of IOS are sufficient in quantity and quality for most organisations. Flexibility problems, however, do occur for organisations at the stage of software integration. In particular 42% of organisations experienced problems in trying to integrate IOS software with existing IS. This integration problem represents a degree of technological inflexibility in the sense that it is a barrier which is reducing the overall levels of benefits that are attainable from IOS.

While each of the technological aspects of IOS pose some level of inflexibility, the majority of organisations did not consider flexibility an important decision

criteria when choosing IOS technologies. In addition, the inflexibilities of IOS technologies are not seen to be a constraining business factor. This is clearly shown in the fact that only 3% of organisations believe that IOS will restrict their ability to adapt to changing business requirements.

Investigation of the second research question reveals that using IOS has a positive effect on flexibility for the majority of organisations. Improvements in flexibility are being obtained due to increased efficiency, responsiveness, versatility and robustness. These improvements are being achieved both within the organisation and also across the links to trading partners.

The third research question sought to examine variables that might explain why organisations differ in terms of the degree of flexibility that they achieve from IOS. In this regard the size of the organisation in terms of either annual turnover or employee numbers is not found to be related to the degree of flexibility being achieved. Thus large and small organisations are equally likely to achieve the same levels of flexibility. Similarly, the industry sector in which an organisation operates is not a good predictor of the extent to which IOS provide flexibility. No sector is gaining significantly higher levels of organisational flexibility relative to another.

Further analysis however indicates that certain characteristics of organisations may account for the different levels of flexibility being attained. Characteristics which are found to have a positive relationship with the level of flexibility include, (i) adopting IOS for offensive competitive reasons, (ii) integrating the IOS plan with the IS plan, (iii) integrating the IOS plan with the business plan, (iv) initiating the adoption of IOS, (v) integrating IOS with other IS software in the organisation, (v) possessing high levels of internal IT expertise, (vi) operating in a competitive environment and (vii) longevity of IOS use.

Having established the viability of the three research questions, there exists a need to enrich the findings of the survey with more in-depth study. In particular,

given that IOS by definition cross organisational boundaries, there is a need to study in detail the linkages between organisations. It is proposed that one way to do this is to study entire value chains. This enables the enrichment of the survey findings. The next chapter presents the findings of two case studies which research these relationships along two specific value chains.

CHAPTER 7

Case Studies

7.1 Introduction

This chapter presents the findings of the case study portion of this study. The purpose of this part of the study is to explore in more detail in specific organisations the findings of chapter 6. The chapter, first, provides details on the organisations who participated in this stage of the research and the rationale for choosing them. Next, it discusses how important the managers interviewed perceive flexibility to be for their organisations. Then the types of IOS that these organisations use are outlined. There follows a discussion on how the technology used for IOS effects flexibility. In the next section the ways in which IOS provide flexibility are discussed. A more in-depth analysis of the organisational factors which effect the level of flexibility obtainable is then presented. Next, the issue of how IOS have affected the flexibility of the entire value chain is presented. The chapter finishes by comparing the findings of the case studies and the survey research and from this conclusions are drawn.

7.2 Participating organisations

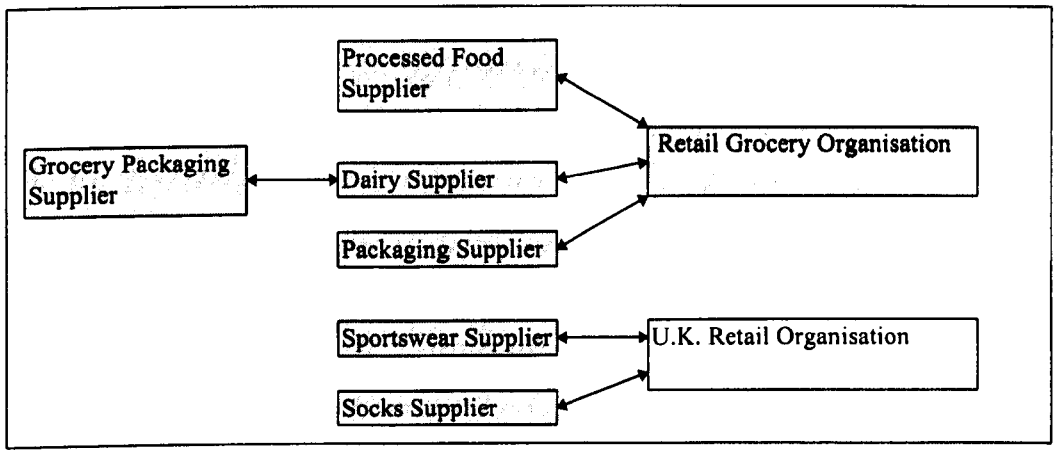
The purpose of this stage of the research is to augment the survey research (Gable, 1994). Specifically, the case studies were conducted to enable more in depth analysis of the findings from the survey (Kaplan and Duchon, 1988; Lee, 1991). The objective of this stage of the research is to explore in greater detail the connection between IOS and flexibility. In pursuing this aim the best unit of analysis for the case studies is the entire value chain (Kambil and Short, 1994; Fredriksson and Vilgon, 1996). The reason for this is that IOS may connect many

distinct organisational types at different points along the value chain together. Therefore, in order to get a complete picture of the effect of IOS, it is necessary to evaluate organisations at each stage of the value chain (Clarke, 1992). Given the exploratory nature of this study and the time constraints under which it was conducted two value chains are explored.

In choosing which networks to investigate the survey results were examined to ascertain the main sectors in which IOS are being used (Figure 6.4). The majority of organisations (54%) operate in the manufacturing and production sector and the second largest sector using IOS is wholesaling and distribution (19%). Further analysis by the researcher of the names of the individual organisations who responded revealed that these organisations operate predominantly in retail grocery networks and information technology manufacturing networks. On the basis of these results the two case studies chosen for further investigation were a manufacturing network and a retail grocery network. Having selected the two networks, organisations were chosen on the basis of willingness to co-operate and organisational characteristics.

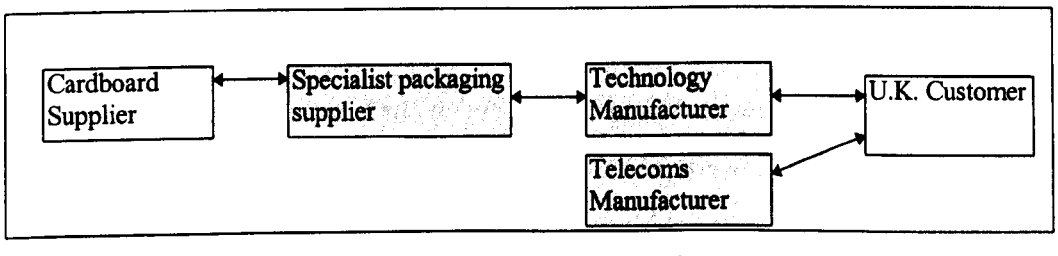
The preliminary selection of organisations to participate in this stage of the study was comprised of those organisations who agreed during the postal survey to participate further in the study. Forty four organisations expressed a willingness to participate further in the study and agreed to make themselves available for interview. These organisations were associated with their respective value chains in order to facilitate the selection of appropriate firms. At a minimum one organisation was selected at each stage of the value chain and where possible two were chosen. In order to obtain alternative viewpoints, in situations where two organisations at the same stage of the value chain where selected, the organisations were differentiated as far as was possible on the basis of contrasting characteristics which the survey shows to be important. Companies were chosen on the basis of comparative differences in terms of size, degree of integration of IOS software with existing IS and whether the organisation was an initiator or non-initiator of IOS.

In total 10 interviews were conducted, 7 in the retail grocery network and three in the manufacturing network. In the retail grocery network, one organisation who sells to the public, three of its suppliers and one organisation who provides materials to these suppliers were interviewed (Organisational profiles are provided in Appendix 6). In addition two organisations who supply clothing to retail organisations are examined. While these organisations are not suppliers of the retail organisation interviewed, they provide additional depth to the analysis on the basis that their customers are predominantly retail chains in the UK.



Note: Gray shaded boxes represent organisations interviewed

Figure 7.1: Retail network



Note: Gray shaded boxes represent organisations interviewed

Figure 7.2: Manufacturing network

In the manufacturing value chain, two manufacturing organisations supplying a large UK multinational company were interviewed. In addition, one supplier was interviewed. The profiles of these organisations is provided in Appendix 6. Neither of the manufacturers have IOS operating with any Irish customers and hence none could be interviewed.

During each interview a semi-structured questionnaire was followed (Appendix 6). The main areas on which the questionnaire focuses are, (i) the importance of flexibility to organisations, (ii) the type of IOS being used, (iii) the flexibility of IOS technology, (iv) IOS use and flexibility and (v) the effect of IOS on the flexibility of the value chain. The questionnaire provided structure to ensure consistency across interviews. Also, areas that appeared to offer possibilities for extra analysis were explored in more depth through additional probing questions. The five sections of the interview guide provide a framework for comparing and contrasting the differing viewpoints of the organisations' interviewees.

7.3 Flexibility as an objective of organisations

All of the managers interviewed believe that flexibility is an important objective for their organisation. As pointed out in the literature all see flexibility as a 'good thing' (Adler, 1988; Avison et al., 1995). All believe that the requirement to be flexible will become more important in the future. The flexibility being sought by organisations is a capability to be able to respond to customer demands and to negate initiatives by competitors. The importance of flexibility is summed up in the response of the Socks Supplier's EDI manager who, when asked how important an objective being a flexible company is, stated:

> 'Well, if we are not flexible we will not make the sale.'

Three of the organisations, who are small relative to their direct competitors, believe that their ability to be 'flexible and adaptable' at short notice to customer

demands is one of their key competitive advantages. The manager with the Grocery Packaging Supplier describes this as follows:

> 'Customer service is of utmost importance to us. Number one is to do what your customer wants and then they will look at you in a different light. If you say "we can't do that", straight away there is a question mark over your company. The market is demanding, the customer is demanding, they want lead-times to be cut, they want to put in an order today and have the goods tomorrow, so we have to have the capacity to do this. We tend to fit a niche in the market where we can be very flexible'.

The survey shows that organisations are competing in a more intense competitive environment relative to the past. The managers in all of the organisations interviewed believe that the markets they operate in are becoming more demanding. The major requirements are a demand to fulfil orders within a shorter time period and the need to provide ever increasing levels of customer service. The need for flexibility due to the new competitive conditions is illustrated in the words of the manger from the Processed Food Supplier:

> 'business is very competitive and is quite aggressive so we have to be able to adapt and change quite quickly'.

Organisations from the retail value network believe that flexibility will become a much more important issue in the future due to the take-over by a large UK retail grocery company of one of the top Irish retail grocery organisations.

While flexibility is viewed as an important trait that organisations need to possess, none of the managers have formulated a definition of what 'flexibility' means precisely for their organisation. Upton (1994) proposes that such confusion and ambiguity about the concept of flexibility seriously inhibits its effective management. For most managers the attainment of flexibility is a 'gut feeling' which is achievable by keeping the organisation as open as possible to change. Surrogate measures being used include a comparison with direct competitors in terms of how quickly the organisation has reacted, and can react,

to competitive or market changes. For the Technology Manufacturer the most important metric is customer care which includes a measure regarding on-time delivery. For the Dairy Supplier flexibility is measured in terms of the percentage of orders that are delivered late.

Organisations are achieving flexibility in different ways. Some are investing in extra machinery while others are carrying buffer stock to cater for the shorter lead times demanded by customers. The Sportswear Supplier has increased its flexibility by having redundant production machines which were purchased second-hand. The availability of two machines means that less time is wasted in changing over the machines to manufacture different products.

The case studies demonstrate that flexibility is an important objective of organisations. It is becoming more significant due to the increasingly competitive situations that firms face. Despite its importance flexibility is not directly measured by organisations. The next section discusses the extent to which organisations consider flexibility an important decision criterion when adopting IOS.

7.4 Reasons for adopting IOS

The survey shows that the number one reason for adopting IOS is a desire to improve customer service. Nine of the organisations interviewed started to use IOS as a result of a customer request. As such, for most it was a defensive rather than an offensive undertaking. The adoption was required according to one manager in order to

'stay in the market and prevent ourselves from being eliminated'.

These organisations view IOS as a capability that they need to possess in order to service customers.

The attainment of flexibility from IOS was not a stated objective. However, the intent was to improve responsiveness to customers. Further, the intent of this responsiveness was external, i.e. the flexibility being achieved is benefiting the organisations' customers. As such, in terms of the focus dimension of flexibility, the responsiveness was externally directed. The possibility of gaining flexibility from IOS in terms of efficiency, versatility or robustness was not considered by these organisations.

For one company, the Retail Grocery Organisation, the decision to adopt EDI was made at the level of the board of directors. The decision was made in light of the fact that some of their competitors had already adopted such systems. When asked if the desire to make the organisation more flexible was one of the initial reasons for adopting EDI the manager replied:

> 'Yes, but the word flexible would not really have come up. It would have been more efficiency and cost savings and time reduction in processing some of the information'.

As such in adopting EDI the Retail Grocery Organisation did seek to gain flexibility in terms of efficiency and responsiveness. In addition, in terms of the focus dimension of flexibility the changes were directed internally. However, robustness and versatility, the other two metrics of flexibility as defined in this research, were not actively sought.

7.5 Types of IOS

All of the organisations use more than one type of IOS. All currently use EDI (Figure 7.3) and in order to aid comparison between organisations each one was asked questions relating to their use of EDI. The confining of the research predominantly to one type of IOS is justified on the basis that the postal survey shows that 80% of organisations use this type of IOS. In addition, EDI is the only type of IOS which is found to span the length of the networks chosen for further analysis.

While the interviews focused on EDI, where appropriate comments on the other types of IOS in use were solicited. The ability to obtain views on more than one IOS within an organisation is one of the reasons why a case study research approach was adopted. Seven organisations believe that EDI is the most significant of all IOS they use, however, three organisations judge e-mail as being the most important.

Type of IOS	Number of firms
Electronic Data Interchange (EDI) of business documents	10
Letting a trading partner query your information system or database	1
Query of a trading partner's information system or database	1
Transfer of files such as spreadsheet and word processing documents	7
Transfer of files such as engineering drawings	5
Electronic funds transfer	4
Financial information (Cash management, Bank reconciliation's)	2
Your Company has a World Wide Web Home Page	5
Internet access to World Wide Web	7
Electronic mail externally	8

Figure 7.3: Types of IOS used by organisations interviewed

7.6 Technological flexibility

The first research question in this study is to assess the extent to which the technology used for IOS provides flexibility. The survey shows that the technology provides flexibility in that it enables organisations to communicate. However, the survey also finds that organisations believe that messaging standards, telecommunications methods and software could be more flexible. This section presents the case study findings which sought to elaborate on these survey results.

7.6.1 Importance of flexibility in deciding on IOS technology

The survey shows that 70% of organisations have their messaging standards chosen for them by their trading partners. In the case studies 9 of the 10 organisations initially adopted IOS as a result of customer requests. For the 9 organisations the IOS technology they now use was prescribed for them by their customers. At the time of the adoption the issue of the flexibility of IOS technology was not addressed by any of these organisations. The manager from the Socks Supplier describes their decision making process as follows:

> 'Initially, we were not very flexible we did not know what we were buying, we just knew we had to deal with EDI customers and that we had to get going on it so we basically just went to the marketplace, bought what was there and flexibility was something we learned to worry about later. It was not a consideration at the start'.

For the Retail Grocery Organisation, an initiator of IOS, the flexibility of IOS technology was deemed to be a very important consideration at the time the system was adopted. This was due to the fact that the organisation had just completely upgraded their core system from a COBOL-based file system to a database system. The enormity of this task and the constraints that the previous system placed on the organisation made them conscious of not adopting a technology that might prove to be inflexible.

7.6.2 Telecommunications

The survey shows that 38% of organisations experience problems with IOS due to the incompatibility of different VANS. This finding is in keeping with previous research (Janssens and Cuyvers, 1991). In the case studies only four of the ten organisations are using EDI between different VANS and all have experienced incompatibility problems. Of the six remaining organisations, three use EDI to communicate with a single trading partner and the other three have

not tried to extend EDI usage beyond their existing VANS. As such these six organisations have no experience of VANS inter-connectivity and are unaware of any problems.

The Retail Grocery Organisation, who trades exclusively within Ireland, had problems in the past with the inter-connectivity of the two main VANS operating in the country. However, these problems have now been resolved. Organisations who trade electronically using EDI outside Ireland continue to experience problems with inter-connectivity of VANS. In the Socks Supplier case most of their customers will not accept VANS interconnections, even though it is now technically feasible. This results in a requirement to maintain accounts with VANS providers in both Ireland and the UK. The EDI manager stated the following regarding VANS interconnections:

> 'We have been using EDI here for the last four years but we feel that the retailers in the UK are laying down the law and have decided to use EDI in a very inflexible manner from the supplier's point of view. They say you have to use this network, these standards and this software'.

The main problem is that an organisation using multiple VANS has no guarantee of delivery. The EDI manager at the Technology Manufacturer summarised the problem as follows:

> 'Most of the VANS will now talk to each other via X400 messaging. So you think you have something set up, and if you are lucky, you will get reconciliation reports back to say that a message was delivered at the far end, other times you won't'.

The case studies demonstrate that all of the organisations who attempt to inter-connect between VANS experience problems. This may indicate that the extent of the problem is understated in the survey because these results include organisations who have not tried to extend EDI to include trading partners from other VANS. The existence of such problems impacts on the flexibility attainable

from IOS. In particular, it reduces the robustness of IOS technology as it makes it more difficult to expand the trading network.

7.6.3 Messaging standards

Massetti and Zmud (1996) in their research find that organisations striving to expand the range of their EDI document base must adapt a variety of document exchange formats, including different messaging standards. The case studies support this research. Five organisations have not tried to extend the reach of EDI to additional trading partners. These firms have not experienced any problems with EDI messaging standards. However, organisations who are connected to multiple trading partners do experience difficulties. These problems manifest themselves in four areas, the verbosity of agreed messaging standards, modification of an agreed standard (Cavaye, 1995), multiple versions of an agreed standard (Horluck, 1994), and multiple standards (Edwards, 1987).

The first problematic issue is the verbosity of EDI standards. In trying to accommodate the complex requirements of a universally applicable system, standards such as EDIFACT need to produce new versions almost yearly. In accommodating all requirements the objective is to keep the standard as flexible as possible. The EDI manager of the Retail Grocery Organisation believes that:

> 'The standards are inflexible. I appreciate that the standards do try to cater for every type of industry and every situation, but the standard can be a monster to use'.

Further evidence of the perceived verbosity of EDI messaging standards is provided by the Technology Manufacturer. The organisation does not use EDI standards for transmitting orders, invoices etc. to sister organisations, even though it possesses the capability to do so. Instead, a structured internal file format is used. The reason for the use of such an internal standard is explained by the EDI manager as follows:

'We only want the information that is going to be loaded into our applications, and because of the nature of our business, we know exactly the sort of information that we want, and rather than having to plough through every EDIFACT segmented message, we have an internal messaging standard that reflects our business now and in relation to our five year plan'.

The decision to use an internal standard instead of an EDI standard is predominantly due to the verbosity of the latter.

The second problem with messaging standards is that 'standards are not standard' (Cavaye, 1995). The Dairy Supplier experiences difficulties due to trading partners interpreting the same messaging standard differently. This results in the requirement to support different versions of invoices within the EDIFACT standard. The Technology Manufacturer, in order to be able to communicate via EDI with different trading partners, has to 'bend the rules of the agreed standard ever so slightly'. While the EDI manager admits that this is not ideal, in his opinion

'in the real world we have to conduct our business, and if we have to bend or break a few rules to keep the business information flow going, then we certainly will do it.'

This requirement to 'tweak' individual installations of the EDI standards results in the need to effectively manage multiple systems. No longer does one generic standard exist but rather many tiny variations of that standard. This inhibits the flexibility of an organisation to upgrade or change, due to the need to replicate the change many times across the slightly different installations.

The complexity of the EDI standards results in organisations not upgrading to new versions when they arrive. The Retail Grocery Organisation is currently using the EDIFACT standard that is two versions behind the current version. The rationale for this is that:

'It has taken us so long to get this far that there is no business benefit to be gained by changing'.

The Retail Grocery Organisation has collaborated with its two main direct competitors to establish which versions of the EDIFACT standard are to be supported within the sector. Together these three organisations account for 70% of all grocery goods sold in Ireland. Such a collaboration was possible due to the commonality of suppliers. This has resulted in the organisation not having to support too many versions. The action was taken at a stage when it was already supporting two versions and the fear was that in time that would increase. The Technology Manufacturer is currently supporting three to four versions of the same standard to accommodate customers.

The result of supporting multiple versions of the same EDI standard is that the translation of messages becomes layered with complexity. The multiple versions, in effect, result in an organisation supporting many EDI systems. This increases the cost of maintenance and reduces the capability of an organisation to change, resulting in a loss of flexibility.

The fourth problem with respect to messaging standards is the need to support multiple standards. Four of the organisations trade outside Ireland and are required to use prescribed EDI standards. In the Irish retail sector organisations use EDIFACT, while organisations in the UK use TRADACOMS. Thus, the three organisations who supply to retail firms in Ireland and the UK are required to support both standards. According to the EDI manager of Socks Suppliers this

> 'squares the complexity of the EDI systems because the two standards run independently'.

In the manufacturing network the Technology Manufacturer is conducting business with trading partners in both the USA and Europe. In order to do this they are required to support the ANSI X12 standard for their USA trading partners and EDIFACT for their European trading partners.

Thus, for organisations who use EDI with a variety of different trading partners, complexity issues arise. These come in four main areas, the verbosity of EDI standards, individual 'tweaking' of an EDI standard, multiple versions of the

same EDI standard and the use of different EDI standards. For organisations such as the Technology Manufacturer who have many EDI trading partners, all four may exist concurrently. In order to manage the complexity the organisation has specifically designed software to understand and translate EDI messages from one format to another.

7.6.4 Software

The survey shows that 45% of organisations believe adequate IOS software is available. Six case study organisations have not experienced any problems with their EDI software. Three of these are using EDI to communicate with only one trading partner. The other three communicate within Ireland using a single VANS. For all of these, one software package is sufficient. However for the four organisations who trade with firms on different VANS there is a requirement to install and use multiple software packages. Both the Socks Supplier and the Sportswear Supplier are required to do so due to customers' insistence that a specific EDI software package be used.

For the Dairy Supplier multiple software is required as they supply both Irish and UK retailers. All of their Irish customers use the same VANS and communicate using EDIFACT. However, UK retailers use a different standard namely TRADACOMS. This means that a separate software module must be installed to communicate with the UK customers.

In the manufacturing network the Technology Manufacturer communicates with multinational suppliers who adopted EDI before any off-the-shelf software existed. As a result these suppliers wrote their EDI software around their IS at that time. This has made the EDI system inflexible. For example, one such supplier is unable to accept and process purchase order changes, a standard document, via EDI and the Technology Manufacturer has to send them manually.

The case studies indicate that in situations where organisations expand the use of EDI to multiple trading partners in different geographic regions or on different VANS, multiple EDI software may be required. The brunt of supporting multiple EDI software packages normally falls with supplier organisations. This is due to the requirement to accommodate their customers' request right down to using the EDI software specified. The use of multiple software packages in turn reduces the flexibility of the organisation as communicating via EDI becomes more complicated than is necessary. These complications reduce the flexibility of a firm by inhibiting efficiency and responsiveness.

7.6.5 IOS restrict the ability of organisations to adapt

The survey shows that 80% of organisations believe that IOS will not restrict the firm's ability to adapt to changing business requirements. The case studies investigates this belief. The finding is that while the technology may be, in some ways, restrictive, organisations believe that technological problems can be solved. This view is best expressed by the Processed Food IS manager who believes that IOS will not restrict his organisation because

> 'really with technology you can do whatever you want, there is nothing that you can't do. It may take a certain amount of work, programming, development or whatever, but technology has advanced so much now, you can get a solution to anything'.

All of the organisations believe that if the IOS became too inflexible then resources would be devoted to it which would solve the problem. According to the EDI manager of the Dairy Supplier

> 'You can solve any problems with EDI. Basically, we get around most problems, there is nothing really that we cannot solve because we have an in-house team'

The smaller organisations buy in the expertise, normally from a VANS, to develop and implement EDI. As such organisations believe that any IOS

technological problem that might constrain the business can be solved by additional systems development.

7.6.6 Non-EDI IOS

Three of the organisations view electronic-mail as being more important that EDI. Their use of e-mail differs, the Grocery Packaging Supplier uses it to send and receive files in a specific software format. The Dairy Supplier believes that using e-mail over the internet might offer an alternative telecommunications method to VANS. The Processed Food Supplier has started to use e-mail as an alternative to facsimile.

The Grocery Packaging Supplier uses e-mail to increase flexibility by improving their responsiveness to customers. This is done by sharing computer aided design files which contain drawings of packaging design specifications. E-mailing eliminates the time delay caused in having to wait for a paper copy of the specification to be delivered. Other telecommunication services such as facsimile are inappropriate due to the inability to send colour copies. The provision of such a service according to the manager in the Grocery Packaging Supplier

'is another way of getting tied into your customer'.

The Dairy Supplier aspires to using e-mail to transfer files in EDI format. The purpose of this is to eliminate the costs of VANS, which the EDI manager views as:

'The most expensive postal system that I have ever come across'.

Three other managers believe that over time EDI will become internet-based. Presently these managers are monitoring developments with regard to security and verification. When these issues have been resolved satisfactorily they believe that a move towards internet based, rather than VANS-based, interconnections will take place.

The Processed Food Supplier has started to use e-mail to send messages that previously have been sent via facsimile to customers. The EDI manager believes this trend will continue and the sending of repetitive weekly information such as summarised stock purchases will be automated using e-mail.

The Technology Manufacturer is developing new types of IOS and believes that:

> 'EDI is good for sending traditional EDI documents such as purchase orders, confirmations, forecasts and invoices but is not designed to handle newer types of document exchange'.

In particular the manufacturer has a pilot project underway using the World Wide Web (WWW) which will allow customers to create orders. Due to the complexity of the company's products it is not possible for customers to use current EDI standards to place purchase orders. A WWW page is being piloted which will enable customers to configure the customised product that they require from the Technology Manufacturer. The movement to a WWW-based IOS is because EDI messaging standards are not flexible enough to accommodate the company's requirements.

7.6.7 Discussion

The survey highlights that some organisations have problems with IOS technology due to its inflexibility. The case studies verify this finding. However, they also show that the difficulties being experienced are confined to organisations that extend EDI usage. The difficulties for these organisations arise due to the existence of multiplicity in the use of telecommunications providers, EDI standards, the versions of a particular EDI standard, and EDI software.

Those organisations who only integrate backward to their suppliers may not suffer the problems of technological multiplicity because they can strongly suggest, or force their suppliers to adopt their specified technologies. For supplier organisations who use EDI to integrate forward to many customers technological

multiplicity is a problem. These organisations often have to support multiple VANS, EDI standards, versions of an individual EDI standard and EDI software packages, to meet the different requirements of their individual customers. The larger the number of trading partners being dealt with, the greater the chance that all four types of multiplicity will be encountered.

The existence of such technological multiplicity constrains supplier organisations. In particular, it makes EDI systems less flexible than they otherwise might be if only one form of each of the core technologies was in use. Supporting multiple technologies appears to have knock-on effects. In order to integrate EDI systems into existing IS, multiple integration's are required. The additional complexity of having multiple forms of EDI prohibits some organisations faced with such problems from seamlessly integrating with existing IS.

The problems with EDI technologies limit the efficiency, versatility and robustness of IOS, by preventing the easy extension of EDI to additional trading partners. Furthermore there is a requirement to support multiple EDI systems. This limitation on flexibility is accepted by organisations. However, all ten organisations believe that IOS will not restrict their ability to adapt to changing business requirements. As such EDI is viewed as being important for flexibility in terms of responsiveness. If the responsiveness of EDI falls below an acceptable level then organisations will act.

7.7 Organisational flexibility

The second research objective of this study is to ascertain the extent to which IOS use provide flexibility. None of the case study organisations believe that IOS use reduces flexibility. The manager at the Technology Manufacturer believes that IOS

'enforce flexibility and versatility and the ability to react quickly, in a timely manner'.

The only aspect of IOS which organisations believe reduces flexibility is the constraints outlined above regarding the technologies required to use such systems.

7.7.1 Sharing of increased flexibility between trading partners

While flexibility is being gained from the use of IOS, the survey found that the flexibility being obtained is not shared equally between initiators and non-initiators of IOS. The case studies verify this finding. All nine organisations who did not initiate IOS believe that the benefits are not shared equally. The EDI manager of the only initiating organisation, the Retail Grocery Organisation, admits that

'while we would like to think that the benefits are shared equally, the reality is probably that they are not'.

The big benefit for the organisation is that EDI enables them to receive invoices electronically which eliminates the need to key in information. The savings on re-keying are substantial. Before EDI it took one individual 1 to 1.5 days each week to process and key in the invoice of one large supplier. This is now achieved in 2 to 3 minutes using EDI. In addition the information being transmitted via EDI is much more detailed than prior to the introduction of the system. Hence, the Retail Grocery Organisation now has - thanks to EDI - information which they use to conduct detailed profitability analysis per item sold. As such IOS - thanks to their suppliers - is providing them with increased internal efficiency.

Some of the supplier organisations believe that the pricing structure of the Irish VANS they are required to use contributes to the benefits of IOS being unevenly distributed. With EIRTRADE the sender pays for the transaction. Currently, in the retail sector the most frequently transmitted messages are invoices sent by

suppliers to the Retail Grocery Organisation. Hence, suppliers must bear the telecommunications cost of providing detailed product line information to the Retail Grocery Organisation.

IOS are increasing the pressure on the suppliers. This is particularly evident in the decreasing lead times and requirements to carry additional stock to cater for the reducing lead times. The manager at the Sportswear Supplier believes that the impact of EDI is that:

'We are basically being asked to respond faster for the same price'.

However the Socks Supplier, supplying similar UK Retail Organisations, is managing this requirement by working in partnership with their customers. This partnership requires the retail organisations to provide a three month forecast, detailed week by week. This forecast enables the Sock Supplier to build up 'EDI buffer stock'. This is stock which is manufactured ahead of actual sales orders so that the supplies can meet the tight turnaround times being requested by the retail organisations.

IOS fail to provide any administrative savings for most supplier organisations. This is because, in the majority of cases, IOS are a way of doing business which is not integrated into the existing information systems. Operating IOS requires companies to create a report in electronic form which can be transmitted to their trading partners but which has no intrinsic value to the organisation preparing the report. As such the IOS are improving the efficiency of their trading partners. The degree to which this is an administration task is summed up by the manager at the Packaging Supplier who sees the provision of information via EDI to the Retail Grocery Organisation as

'something else we have to do on a Friday'.

Each Friday invoice details are sent via EDI to the Retail Grocery Organisation. The information exists already in the Packaging Supplier's own internal accounting IS. Translating it into the EDI standard is done solely to enable the retailer to receive the invoice electronically. The lack of any substantial benefit to

suppliers is demonstrated in the words of the manager from the Dairy Supplier who said that

> 'we are gaining from EDI, to the extent that we can do the business'.

7.7.2 Information being transmitted via IOS along the value chain

The importance of IOS to organisations appears to be related to the volume of data that they receive through it. In the retail network the data flow via EDI between the Retail Grocery Organisation and its suppliers is one way. Currently, suppliers provide price listings and invoice data to the Retail Grocery Organisation. For the Retail Grocery Organisation EDI is providing more detailed information on their purchases. Prior to EDI only total amounts from each supplier were available. Now the information regarding the amount owing to each supplier can be divided on the basis of individual products.

While some information is provided by the Retail Grocery Organisation to specific suppliers this occurs outside the EDI system and it is ad hoc and informal. The manager of the Processed Food Supplier is of the opinion that the benefits of EDI would be increased substantially if the Retail Grocery Organisation provided them with forecast information. The provision of such data would be especially valuable to the Processed Food Supplier as they supply perishable goods with short shelf lives.

The UK retail organisations, unlike the Irish retail organisations, do provide their suppliers with forecasts via EDI. The Socks Supplier believes these forecasts are a critical component in the success of EDI. In the words of the EDI manager:

> 'Most of our customers will not supply us with forecasts. They would prefer to keep us out on a limb. In the case of customers who use EDI however the relationship is very professional and forecasts are provided via EDI, some of them automatically'

The actual process involves the Socks Supplier providing the retail organisations with stock availability information, from which the retailer will order. To ensure that stocks will be available when required the retail organisations provide the supplier with weekly forecasts for the following three months. This sharing of forecast information is very beneficial to the Socks Supplier in facilitating better production scheduling.

In addition, the manager at the Socks Supplier believes that the sharing of the data between both parties facilitates the building of trust which results in partnership type arrangements. Evidence of such partnership can be seen in that one of the retail organisations now automatically issues an electronic contract with the forecast.

As such one of the determinants of the degree of flexibility which IOS provide may be the amount of data that is shared along the value chain. In situations where one organisation is receiving all of the information but providing none in return the level of flexibility of the value chain may be lower than in situations where information is shared. In particular, the provision by customers of sales forecasts can help suppliers to be more flexible in their production and delivery schedules.

7.7.3 Discussion

IOS, for most supplying organisations are a cost of doing business with customers. It is a customer service tool. The flexibility being generated by IOS is not being shared equally along the value chain. For most of the supplier organisations IOS are just an administrative function that they are required to perform for the sake of their customers. The customers, for example the retail organisations in the retail network, are accruing benefits in the form of reduced administrative costs and improved information flow.

The survey finds that IOS has improved responsiveness for 88% of organisations and efficiency for 63% of firms. The case studies illustrate that the reason for this difference may be in the way IOS are used. The organisations who are gaining more flexibility are usually those who receive large volume of information electronically. The large data flow provides these organisations with efficiency and responsiveness. For both organisations using IOS to benefit, a high degree of trust must exist. This trust enables increasing volumes of data to be shared electronically, such as forecasts, which results in increased flexibility in the form of efficiency and responsiveness for both organisations.

7.8 Organisation factors

The third research question of this study is to ascertain if certain organisational factors influence the degree of flexibility being achieved by different IOS participants. The survey verifies the research question and identifies some influential organisational factors. The case study research takes some of these identified relationships and explores them further.

7.8.1 IOS connection to business strategy

The organisations can be categorised in three ways in terms of how IOS relate to business strategies. First, there is the Retail Grocery Organisation for whom the system, since its inception, has always been a central part of business strategy. Second, two organisations did not initially integrate IOS with their business strategy but have since done so. The remaining seven organisations have not integrated IOS with the business strategy.

The Retail Grocery Organisation is using EDI to make the supply chain more efficient in terms of costs and lead times - a central tenet of their business strategy. The conversion from being reactive to proactive has been dramatic for

two organisations as evidenced by the views of the EDI manager for the Technology Manufacturer:

> 'In the beginning we hated EDI and didn't even want to learn how to use it. Now we can't function without our electronic commerce systems. There is a total reliance on them. The organisation would be on its knees within 5 days if we lost all of our links.'

The second organisation, the Socks Supplier, market their EDI capability and believe that it helps them gain more customers. As part of integrating the EDI system into the business strategy this organisation is now using the system to obtain forecasts from suppliers which greatly improves their production planning process.

The seven organisations who have not made IOS part of their business strategy do not try to progressively develop the system, but rather incorporate changes when requested to do so by trading partners. These organisations perceive IOS as an infrastructure unrelated to their business strategies. IOS operate as a customer service tool, a requirement of gaining contracts with customers. Any development to IOS happen as a result of a trading partner request. This attitude is demonstrated by one manager as follows:

> 'We will not do anything with IOS unless we are forced to.'

These organisations view IOS as an expensive postal system, the cost of which they have to bear in order to do business with the trading partners who have requested it.

The three organisations who have integrated IOS into their business strategy are obtaining additional benefits relative to those who have not. This finding is similar to the survey which shows that organisations who integrate their IOS plans and their business plans achieve higher levels of flexibility. The manager with the Socks Supplier believes that the customers connected to them via IOS linkages are predominantly the most progressive in terms of technology and business ideas. Being connected to such organisations facilitates flexibility through communications from these customer organisations who are more aware

of the changes occurring in the marketplace. The Technology Manufacturer believes that IOS provide the ability to explore and open up new markets world-wide.

7.8.2 Integration of EDI software with internal IS

Swatman and Swatman (1991) propose that EDI software can be integrated with internal IS at different levels. Previous research shows that increased levels of benefits are gained by organisations who integrate their EDI systems and internal IS (Baker, 1991; Mackay, 1993; Cox and Ghoneim, 1994). The survey finds this relationship also holds for flexibility, in that the more integrated these two systems are the higher the level of flexibility that is obtainable.

The case studies sought to expand the survey finding by obtaining examples of how integrated systems improve flexibility. The perceived importance of having the EDI software seamlessly integrated with existing information systems varies among the organisations interviewed. The EDI system resides on a stand alone personal computer system in two of the organisations interviewed. The reasons for this vary. The Grocery Packaging Supplier has not integrated it because no facility exists within the current internal information system to do so. The Sportswear Supplier has decided not to integrate the systems as various customers require different EDI software packages. Presently the organisation would have to write three different conversion tables for three different suppliers in order to integrate the systems. The benefits to be derived from EDI are not believed to be sufficient to warrant writing such software.

Seven organisations have partially integrated the two information systems. For the Packaging Supplier this was accomplished by contracting out the writing of the software required to perform the downloading process. Four organisations have not seamlessly integrated the two systems because the completion of such a project is not seen as a priority. The Technology Manufacturer has chosen not to

seamlessly integrate the EDI system with internal IS. In this organisation the business process requires that the data being received be validated manually. Thus, each order is reviewed on screen and verified before entering the internal IS. The reason for this is that for the Technology Manufacturer each order is for a complex product and there is a need to have an expert evaluate the order to ensure that it complies with different criteria. The same does not hold in the retail network where the orders being received are for standard goods.

Two of the organisations, the Technology Manufacturer and the Retail Grocery Organisation, put the EDI file through a translation process before sending it to their internal IS (Figure 7.4). The purpose of the translation software for both organisations is to provide a single translation table which can be amended to enable EDI messages to be deciphered into an understandable format for the internal IS. Both organisations believe that the translation software provides flexibility because it enables the messaging format to be changed without having an effect on the main information systems.

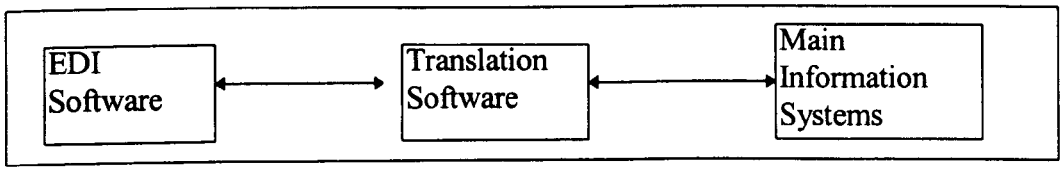


Figure: 7.4: Translation layer

Only one of the organisations, the Retail Grocery Organisation, has seamlessly integrated the EDI system with the internal IS. This integration is perceived to be vital, to the extent that the IS manager said:

'Without integration you can forget using EDI'.

The integrated system enables the automatic provision of data to the organisation's core management information system. This transfer of data from the EDI system to the information system is important because it provides detailed individual product information which enables better decision making.

The importance of having IOS seamlessly integrated with existing IS may be influenced by the sector in which the organisation operates. The Technology Manufacturer has chosen not to adopt a seamless integration between the two systems not due to any technological or organisational constraint but rather because such integration does not fit current business processes. The Retail Grocery Organisation on the other hand believes that integration is essential. The distinguishing characteristic appears to be the volume and nature of the information being transmitted via IOS. In the retail network the information is high volume low value, while in the manufacturing network it is low volume, high value.

The Retail Grocery Organisation is the only organisations that has a seamlessly integrated system. They are also the only firm to have initiated the adoption of EDI. These points may indicate that the decision to seamlessly integrate IOS may be influenced by whether an organisation is driving IOS or is forced to adopt the systems. In the latter case the costs of integrating, in terms of time and money, might out weigh any possible benefits that might be gained.

7.8.3 Discussion

Most organisations, particularly suppliers, see IOS as peripheral systems. These systems are effectively expensive facsimile machines which allow them to fulfil customers wishes to communicate electronically. As such these systems are not integrated into business strategy. The main type of flexibility being gained is responsiveness. Organisations who have made IOS central to their business strategies tend to obtain more flexibility. The type of flexibility being achieved is predominantly increased efficiency and responsiveness.

The cost in time and effort of integrating IOS into internal IS is prohibitive for most organisations. In particular, it is not seen as a priority by those organisations who do not see IOS as part of their business strategy. Organisations who have

seamlessly integrated IOS with internal IS are gaining more flexibility chiefly in terms of increased efficiency.

The case studies illustrate that flexibility can be improved by not integrating IOS into internal IS directly. Instead, a translation software layer is used. This enables the isolation of any changes which are required to this layer and prevents the need to adjust internal IS. Two organisations believe this has substantially improved the flexibility they are gaining from IOS.

7.9 Flexibility of the networks

To explore in greater detail the connection between IOS and flexibility requires that the impact that IOS have along the entire value chain be analysed (Kambil and Short, 1994; Fredriksson and Vilgon, 1996). The reason is that IOS may connect many distinct organisational types at different points along the value chain together. Therefore, in order to get a complete picture of the effect of IOS, it is necessary to evaluate organisations at each stage of the value chain (Clarke, 1992). This section shows how organisations have tried to expand EDI use to additional trading partners. It, then, outlines considerations about extending EDI use to include new types of trading partners. The effect of IOS on the whole value chain is presented. This is followed by a comparison of the retail and manufacturing networks.

7.9.1 Expanding EDI

Expanding the use of EDI systems in terms of additional functionality and trading partners has been a slow process for the Retail Grocery Organisation. In the words of the EDI manager:

> 'It has been a long, long haul. We have been at the invoicing for 3-4 years and it is still not complete. It has been slow and frustrating'.

The experience of the Technology Manufacturer is similar. They are finding it more difficult to expand the use of EDI, in terms of functionality and the number of trading partners, than they envisaged.

> 'We thought that once we had one supplier going, adding additional suppliers would be like turning a tap and you could throw on 5 to 10 a week until you had your main vendors up there. But very quickly we found that every implementation is different in some shape or form. Some of them are very marginally different, others you have real big problems with'.

Organisations who are trying to extend IOS are being frustrated in their attempts to do so. The main reason that trading partners are slow to adopt IOS appears to be that firms perceive no benefit for themselves from IOS and are, thus, unwilling adopters of the technology. As such proactive users of IOS are finding that these systems are not flexible, specifically in the area of external robustness.

7.9.2 Extending EDI usage

Having acquired the technology for IOS, organisations can, if they wish, use this technology to extend its usage by connecting electronically to different types of trading partner. Nine of the organisations interviewed started using IOS initially with customers. Six of these organisations have decided not to extend EDI use to connect to their suppliers.

For most of these organisations there is no current business benefit in connecting to their suppliers. The Dairy Supplier did investigate the possibility of using EDI with suppliers, for example the Grocery Packaging Supplier. However, they decided not to pursue an electronic link due to the fact that most of the items being supplied were purchased in bulk two to three times a year. The Specialist Packaging Supplier created pilot EDI links with the Technology Manufacturer but these have since been discontinued. Orders for packaging are placed by the

Technology Manufacturer twice a year. The onus then resides on the Specialist Packaging Supplier to ensure that packaging is always available when required. To ensure this, a representative from the Specialist Packaging Supplier visits the Technology Manufacturers warehouse each morning to check on stocks. In both of these cases purchases incur little administration costs and do not warrant an EDI connection.

While the Specialist Packaging Supplier currently does not use EDI to its customers it has extended the use of EDI back to its suppliers. The detail required to order supplies is detailed and requires the submission of exact measurements and product codes to the Cardboard supplier. Two other organisations, the Technology Manufacturer and the Socks Supplier, have extended the use of EDI back to suppliers. These links enable the ordering of supplies on a just-in-time basis.

Extending the use of EDI is dependent on the volume and frequency of the data that is currently being transmitted between the prospective EDI trading partners. In situations where the data flow and volume is high extension is likely to occur. The data flow has to be measured between the two connecting organisations and differs at each stage of the value chain. As such it may not be advantageous to create electronic links across the entire value chain.

7.9.3 IOS effect on the complete value chain

The adoption of IOS has an effect along the entire value chain. These can be seen, particularly, in the areas of time compression and efficiency. Information is being transmitted between trading partners faster which is enabling faster response rates. The manager from the Technology Manufacturer described the impact of IOS as follows:

> 'It makes the value chain far more efficient, far more cost effective and far more value added'.

For suppliers of the Retail Grocery Organisation using EDI to send invoices results in payments being made on time more frequently, rather than late. The reason for this is that the invoice enters the Retail Grocery Organisation IS electronically and is automatically matched with deliveries. This ensures that the paperwork is complete in time to fit within the payment cycle.

Emmelhainz (1987) demonstrates that the adoption of IOS leads to a movement towards preferred suppliers. For the Retail Grocery Organisation the lack of adoption of EDI by a supplier can be a factor contributing to the supplier being delisted. The Grocery Packaging Supplier believes that the adoption of EDI has resulted in his organisation becoming a preferred supplier, which, in turn, results in increased sales to the customer.

Bjorn-Anderson and Krcmar (1995) propose that over time the adoption of IOS will increase the possibility of shortcutting the process of doing business by eliminating some of the partners in the distribution channel. None of the organisations have experienced any such change in their value chains. In addition none of the managers believe it is likely to happen in the near future.

The use of IOS can allow organisations to focus on their 'core competencies' (Klein, 1992; Picot et al., 1993). It enables this because it facilitates outsourcing (Piore and Sable, 1984). Nor is it envisioned by the managers interviewed that such dramatic changes are likely to occur in the near future.

In summary, IOS are currently improving the flexibility of the value chain. Specifically, they are improving its efficiency and responsiveness. However, flexibility is not being dramatically enhanced in the forms of versatility and robustness. In particular, the use of IOS is not resulting in increases in outsourcing, or the elimination of any stage in the value chain. As such, the dramatic effects that the literature predicts might occur across the whole value chain have not occurred so far in the two value chains examined. However, there

is some evidence to support previous research which indicates that the adoption of IOS leads organisations to move towards preferred supplier relationships.

7.9.4 IOS usage: Comparison of the two networks

The focus of the EDI systems in use in the two networks is different in certain respects. Given the number of line items per invoice in the retail network the initial focus was on automating the transfer of such information. In the manufacturing network, in contrast, the number of items being ordered per invoice is not substantial and the initial efforts of EDI were focused on forecasting and delivery schedules to facilitate just-in-time inventory management.

Thus, the implementation of any form of IOS is dependent on the business drivers of the organisation who is initiating the new system. These drivers are different across networks and can also be different within the different stages of the same value chain.

7.10 Conclusions

The survey established that IOS provide organisations with flexibility. During the subsequent case studies questions were asked concerning the importance of flexibility to organisations. In the competitive environment of today, organisations see flexibility as an important trait that they should possess. However, organisations do not have a metric for flexibility but rather measure it on a scale relative to other organisations, normally their direct competitors.

The survey found that organisations do not believe the technologies for IOS are as flexible as they might be. The specifics of this issue were explored further in the case studies. In particular, the interviews sought to determine whether the dissatisfaction with the technologies was evenly spread between organisations at

the different stages of the value chain. It was found that the technologies being used in EDI, the predominant type of IOS, are constraining organisations. They are, particularly, constraining supplier organisations who are connected to more than one customer. The reason is that the suppliers are often required to support specific technologies for each customer. This results in supplier organisations having to support multiple EDI software packages, VANS, EDI standards and different versions of EDI standards. This multiplicity constrains the organisations in that the technologies become islands of automation which become difficult to integrate. Thus, the flexibility of being able to conduct EDI on a single platform is lost and is replaced instead with multiplicity.

The survey shows that organisations who initiate IOS achieve higher levels of flexibility. Two organisations in the case study research did not initiate IOS but are achieving high levels of flexibility from IOS. One possible reason for the apparent disparity in this instance between the survey and the case studies may be that the two organisations made IOS a central part of their business strategy. Hence, while they were initially forced into using IOS they encompassed it into their own business strategy. A more appropriate characteristic of organisations who achieve higher levels of flexibility might be the degree to which it is integrated with the business strategy rather than solely whether the organisation initiated the adoption of IOS or not.

Chapter 6 demonstrates that a higher degree of integration between IOS and existing IS software is positively related to the level of flexibility being obtained from IOS. In the interviews this issue was explored in more detail. Most of the supplier organisations are not interested in integrating IOS seamlessly into their existing IS even though they have the capability and expertise to do so. The reason for this is that IOS are not seen as a core system but instead as a customer service requirement. In organisations where IOS are seen to be a core system they have been fully integrated. It appears that it is the centrality of IOS to business objectives rather than technological reasons which results in integration.

Chapter 6 found that the degree of flexibility being gained from IOS is positively related to the number of years that the organisation has been using IOS. Investigation of this point during this stage of the study demonstrates that two distinct groups of organisations exist. There are those organisations who are driving IOS and those who use the system in a minimalistic way to satisfy trading partner requirements. Organisations driving IOS wish to expand its usage to include as many trading partners as possible, while their potential trading partners are resisting the system. In such a climate it is taking the driving organisations a considerable number of years to reach critical mass with IOS. This slow adoption may explain the positive relationship between IOS flexibility and longevity of IOS use.

The degree of flexibility being achieved along an entire value chain is dependent on the extent to which data is shared between the different organisations in the value chain. Those organisations who are receiving forecast information from their customers believe that the flexibility of the value chain has increased substantially. Specifically, it has enabled the supplier organisations to plan their production more efficiently and to reduce their lead times in fulfilling orders. The provision of increased data between trading partners may however have more to do with the degree of trust and partnership that exists between them rather than the existence of any technological capability.

CHAPTER 8

Conclusions and Further Research

8.1 Introduction

Chapter six presents the findings of the survey and chapter seven illustrates the case study research. This chapter combines the findings of this pluralistic research method. Organisations are seeking flexibility as a strategic objective (De Meyer et al., 1989; Lambert and Peppard, 1993; Das and Elango, 1995). Previous research has suggested that information systems, and in particular inter-organisational information systems, can provide flexibility (Lucas and Olson, 1994, Duncan, 1995a). However, research to date on IOS has not operationally defined flexibility or specifically studied the relationship between IOS and flexibility. This study seeks to contribute to IOS research by addressing these issues. The study is exploratory in nature and its objective is to examine the relationship between IOS and flexibility.

The research objective is divided into three research questions. First, to what extent does the technology used for IOS provide flexibility, second, to what extent does the use of IOS provide flexibility and third, what organisational factors influence the variation in the degree of flexibility being achieved by different IOS participants. The answer to these questions provides the structure for this chapter. The chapter concludes with the limitations of this study and potential avenues for further research.

8.2 Types of IOS

The vast majority of the organisations surveyed (80%) are using EDI. The prevalence of EDI can be explained on the basis of the purposive sample and the fact that other forms of IOS, such as the internet, were still relatively immature at the time the survey was conducted. In the case studies all of the organisations use EDI, however three organisations view electronic-mail as being more important that EDI.

8.3 IOS technology

Inter-organisational systems, by definition, require the use of computers and telecommunications. The main technologies required for IOS are first a telecommunications method which provides the means for transmitting the messages, second, messaging standards which facilitate communication, and third, software whose purpose is to act as a translator, converting and understanding messages which have been sent in agreed formats.

8.3.1 Telecommunications methods

The use of value added network services provides flexibility for IOS as it enables organisations to extend the systems usage to new trading partners (Hansen and Hill, 1989). In addition, it provides flexibility because it enables faster communication which improves responsiveness (Emmelhainz, 1990). However, organisations are experiencing problems with VANS not being easily interconnectable. This results in problems with connecting additional trading partners who currently operate on different VANS (Fynes and Ennis, 1993).

The survey shows that 38% of organisations experience problems with IOS due to the incompatibility of different VANS. This finding is in keeping with previous research (Janssens and Cuyvers, 1991). In the case studies only four of

the ten organisations are using EDI between different VANS and all have experienced incompatibility problems. This may indicate that the extent of the problem is understated in the survey because these results include organisations who have not tried to extend EDI to include trading partners from other VANS. The existence of such problems impacts on the flexibility attainable from IOS. In particular, it reduces the robustness of IOS technology as it makes it more difficult to expand the trading network.

8.3.2 Messaging standards

Messaging standards form a vital component of IOS, and in particular of EDI, a subset of IOS. Agreeing the specific messaging standard to be used between two organisations enables them to communicate via computer to computer integration without human intervention. The purpose of such messaging standards is to facilitate the automatic transfer of data. In addition the adoption of messaging standards facilitates flexibility by providing a standard way to communicate.

The majority of organisations believe that messaging standards are flexible. Seventy eight percent of the organisations surveyed use open messaging standards. Such standards provide flexibility in that they facilitate communication with connected firms and allow the connection of additional trading partners easily. A large percentage (45%) believe that the messaging standards are adaptable in foreseen circumstances. However, only 20% believe they can be adapted rapidly in response to unforeseen circumstances. Thus, messaging standards are, for the most part, flexible but are inflexible for unforeseen circumstances where a response is required in a short time frame.

Massetti and Zmud (1996) in their research find that organisations striving to expand the range of their EDI document base must adapt a variety of document exchange formats, including different messaging standards. The case studies support this research. Organisations who are connected to multiple trading

partners experience difficulties. These problems manifest themselves in four areas, the verbosity of agreed messaging standards, modification of an agreed standard (Cavaye, 1995), multiple versions of an agreed standard (Horluck, 1994), and multiple standards (Edwards, 1987). For organisations who have many EDI trading partners, all four may exist concurrently.

8.3.3 Software

The third IOS technology, software, enables each firm to translate the message into the correct format to facilitate its transmission over the telecommunications lines. The software also acts as the interface to translate and understand incoming messages received via IOS.

The majority of organisations are content with the translation software they use. The number of software packages currently on the market to manage the internal component of IOS are sufficient in quantity and quality for most organisations. However, the case studies indicate that in situations where organisations expand the use of EDI to multiple trading partners in different geographic regions or on different VANS, multiple EDI software may be required. The brunt of supporting multiple EDI software packages normally falls with supplier organisations. This is due to the requirement to accommodate their customers' request right down to using the EDI software specified. The use of multiple software packages in turn reduces the flexibility of the organisation as communicating via EDI becomes more complicated than is necessary. These complications reduce the flexibility of a firm by inhibiting efficiency and responsiveness.

8.3.4 Multiplicity of IOS technology

While each of the IOS technologies can pose problems on their own the case studies show that the inflexibility of the technologies become more notable when organisations try to extend IOS usage. The main reason for this is that firms are

required to support multiple value added network services, EDI standards, versions of a single EDI standard and EDI software. While it is technologically feasible to avoid this multiplicity, the insistence by different trading partners that specific technologies be used makes it impossible. Supplier organisations are particularly prone to this phenomenon of having to support what amounts to multiple EDI systems. This multiplicity constrains the organisations in that the technologies become islands of automation which become difficult to integrate. Thus, the flexibility of being able to conduct EDI on a single platform is lost and is replaced instead with multiplicity.

8.3.5 Importance of flexibility when choosing IOS technology

While each of the technological aspects of IOS pose some level of inflexibility, the majority of organisations did not consider flexibility an important decision criteria when choosing IOS technologies. In addition, the inflexibilities of the IOS technologies are not seen to be a constraining business factor. This is clearly shown in the fact that only 3% of the organisations surveyed and none of the managers interviewed believe that IOS will restrict their ability to adapt to changing business requirements.

8.4 Flexibility from IOS

Flexibility is defined in this study as the 'capacity to adapt'. This definition only becomes meaningful when placed within specific contexts, what Evans (1991) calls dimensions. These are specific areas within which flexibility can be obtained. This study defined four dimensions; temporal, range, intention and focus. The first dimension of flexibility, temporal can be described in terms of the length of time it takes an organisation to respond to environmental changes. The second dimension is the degree to which an organisation can adapt to foreseeable and unforeseeable changes. The third dimension of flexibility acknowledges that organisations can adapt to changes proactively or reactively.

Finally the fourth dimension, focus, demonstrates that firms can gain flexibility both internally and as a result of their dealings with other firms.

The four dimensions of flexibility identify fruitful areas where flexibility can be pursued. In order to measure the extent of flexibility being gained along each dimension metrics of flexibility are proposed. These are efficiency, responsiveness, versatility and robustness. These four metrics measure the temporal and range dimensions. By distinguishing whether the effect of the IOS is predominantly focused internally or externally the focus dimension is operationalised. Finally, the intention dimension is operationalised by determining whether an organisation initiated the use of IOS or was requested by a trading partner to do so.

Over 80% of organisations are gaining flexibility as a result of using IOS. Specifically, the majority of organisations are now more efficient, responsive, and robust due to using IOS. Many firms (43%) have improved their versatility with IOS use. The improvements in flexibility are occurring both within the company and with respect to the connections with trading partners. Therefore, on the basis of the combined and individual measures of flexibility derived for the purpose of this exploratory study, it is shown that IOS do provide organisations with improved levels of flexibility.

Firms using IOS gain divergent levels of flexibility in terms of efficiency, responsiveness, versatility and robustness. In addition, organisations differ with respect to the extent to which they obtain flexibility both internally and externally from IOS. The case studies show that one reason for these differences is that the flexibility being gained from the IOS is not equally shared between trading partners. In most cases supplier organisations are requested to adopt IOS by their customers. The customers are accruing most of the increased flexibility in the form of increased efficiency and improved responsiveness.

The survey finds that IOS has improved responsiveness for 88% of organisations and efficiency for 63% of firms. The case studies illustrate that the reason for this difference may be in the way IOS are used. The organisations who are gaining more flexibility are usually those who receive large volume of information electronically. The large data flow provides these organisations with efficiency and responsiveness. For two organisations using IOS to benefit, a high degree of trust must exist. This trust enables increasing volumes of data to be shared electronically, such as forecasts, which results in increased flexibility in the form of efficiency and responsiveness for both organisations.

The case studies investigate the extent to which flexibility is improved along the entire value chain. IOS are currently improving the flexibility of the value chain. Specifically, they are improving efficiency and responsiveness. However, flexibility is not being dramatically enhanced in the forms of versatility and robustness. In particular, the use of IOS is not resulting in increases in outsourcing, or the elimination of any stage in the value chain. As such, the dramatic effects that the literature predicts might occur across the whole value chain have not occurred so far in the two value chains examined (Bjorn-Anderson and Krcmar, 1995). However, there is some evidence to support previous research which indicates that the adoption of IOS leads organisations to move towards preferred supplier relationships (Wang and Seidmann, 1995).

8.5 Organisational Factors

Given that organisations differ in the level of flexibility they gain from IOS, the third research question in this study sought to investigate what organisational factors influence the variation in the degree of flexibility being achieved by different IOS participants.

8.5.1 Organisational size

Larger organisations can often gain more benefits from IOS relative to smaller ones (Webster, 1995). In a similar way this research proposes that a relationship might exist between the size of the organisation and the degree of organisational flexibility which IOS provide. To test this proposition the measures of flexibility obtained are compared with two measures of organisational size; annual turnover and employee numbers. No significant relationship is found to exist between any of the measures of flexibility and either annual turnover or the number of employees. This finding indicates that organisational size is not a determinant of the degree of flexibility achievable from IOS.

8.5.2 Initiating organisations / non-initiating organisations

Important distinctions exist between organisations who initiate IOS and those who do not (Chismar and Meier, 1992). Recognising this the research poses an exploratory proposition that those organisations who initiate IOS achieve more organisational flexibility relative to non-initiating organisations. The survey finds that a significant difference exists between the degree of flexibility being gained by those who initiate IOS and those who do not. The difference is significant for all measures of flexibility.

The reason organisations initiate IOS is also related to the level of flexibility subsequently achieved. Organisations who adopt IOS for reasons of competitive advantage obtain higher levels of flexibility. On the other hand, organisations whose primary reason for adopting IOS is in response to a trading partner request gain significantly lower levels of flexibility.

Further evidence of the existence of differences between initiators and followers is provided by analysing the initial reason for adopting IOS. The reasons for adopting IOS differ significantly depending on whether or not the organisation initiates the system. For initiators, a desire to speed up information provision,

followed by a desire to improve customer service are most important. However, for non-initiators, the overwhelming reason for adopting IOS is because they were requested to do so by a trading partner.

The existence of a difference between initiators and non-initiators is further proven by examining whether any variance exists in how fairly they believe the benefits of IOS are shared between trading partners. A significant difference is found between the two groups as regards their beliefs that the benefits are shared equally (Figure 6.28). Those who initiated IOS are significantly more likely to say that the benefits are being shared equally, while those requested to adopt IOS are significantly more likely to say that the benefits are not equally distributed.

The statistically significant differing viewpoints between initiators and non-initiators on several variables shows that differences exist between the two groups. Further, it has been shown that a statistically significant difference exists between the two groups with regard to the level of organisational flexibility being acquired from IOS. It can be further concluded that initiators achieve higher levels of flexibility relative to non-initiators.

The case studies show that organisations who initiate IOS have clear business objectives in mind. They 'strongly suggest' to their trading partners the requirement to use IOS. Once this has been achieved the initiating organisation gains external flexibility in the form of increased efficiency and responsiveness. However, the trading partners are providing the initiating organisation with this increased flexibility without receiving any flexibility in the form of efficiency in return.

8.5.3 Initial reason for adopting IOS

The initial reasons for adopting IOS have direct effects on the levels of organisational flexibility subsequently achieved from IOS. Those organisations who use IOS as offensive weapons, in the sense of providing competitive

advantage, gain relatively more organisational flexibility. The corollary to this is also true - those organisations who adopt IOS for defensive reasons, in particular because they are requested to do so by other firms, gain relatively less organisational flexibility.

8.5.4 Integration of the IOS plan with other plans

The degree of integration of the IOS plan with the IS plan is positively associated with the degree of flexibility gained. A similar relationship exists with the association of the IOS and business plans. Thus, the higher the level of integration between the plans the higher the degree of flexibility being achieved from IOS. The case studies illustrate that organisations who have made IOS central to their business strategies tend to obtain more flexibility, predominantly increases in efficiency and responsiveness.

8.5.5 IT expertise existing within the organisation

The degree to which an organisation possesses expertise in IT can affect the levels of benefits that they ultimately obtain from IOS (Holland et al., 1992; Sabherwal and Vijayasarathy, 1994; Iacovou et al., 1995). The survey results concur with prior research and find that previous organisational IT experience is seen by most organisations to be beneficial when IOS are being designed and implemented. A sizeable minority however, hold that previous IT experience within the organisation did not assist either the designing or implementation of IOS.

IT expertise is found to be significantly positively related to all of the metrics of flexibility except robustness. The fact that no relationship is found between IT expertise and robustness may relate to the fact that robustness is more of a business or management issue and is not directly affected by the IT expertise that exists within the organisation. In general, however, it can be concluded that higher levels

of internal IT expertise correspond with the attainment of higher levels of organisational flexibility from IOS.

8.5.6 Integration of IOS software with other internal IS

IOS software can be integrated with existing internal IS at different levels (Swatman and Swatman, 1991; Curran, 1991) The extent of such integration has an impact on the levels of benefits being achieved (Baker, 1991; Mackay, 1993). Forty two percent of organisations experienced problems in trying to integrate IOS software with existing IS. This integration problem represents a degree of technological inflexibility in the sense that it is a barrier which is reducing the overall levels of benefits that are attainable from IOS.

The survey shows that the extent to which IOS are integrated with existing IS software is positively related to flexibility. Thus, organisations who fully integrate IOS into existing systems obtain higher levels of flexibility. The flexibility is gained in the form of increased efficiency and responsiveness. The attainment of higher levels of software integration is related to organisational size, longevity of IOS use, and the degree of integration between the IOS and IS plans.

The case studies show that the cost in time and effort of integrating IOS into internal IS is prohibitive for most organisations. In particular, it is not seen as a priority by those organisations who do not see IOS as part of their business strategy. Organisations who have seamlessly integrated IOS with internal IS are gaining more flexibility chiefly in terms of increased efficiency.

Previous literature advocates the need for 'seamless integration' (Swatman and Swatman, 1991). The case studies illustrate that flexibility may be improved by not seamlessly integrating IOS into internal IS directly. Instead, a translation software layer is used. This enables the isolation of any changes which are required to this layer and prevents the need to adjust internal IS. Two

organisations from the case studies believe that this strategy has substantially improved the flexibility they are gaining from IOS.

8.5.7 External environment of organisations using IOS

Sabherwal and Vijayasarathy (1994) find that the degree of environmental uncertainty is a good predictor of the extent of IOS usage. The survey found that the intensity of the external environment is significantly related to flexibility. The relationship indicates that a more turbulent external environment is significantly related to the degree of flexibility being obtained from IOS.

Thus, organisations who compete in markets that are changing rapidly and in which a large amount of diversity is required are more likely to have IOS which provide increasing levels of organisational flexibility. This result indicates that organisations who operate in turbulent markets make use of IOS to improve their flexibility.

8.5.8 Longevity of IOS use

Another potential characteristic which could help explain differences in the levels of flexibility obtained from IOS, is the length of time that IOS have been in use. Flexibility is found to be significantly positively related to the longevity of IOS use. The improved flexibility comes predominantly in the form of internal flexibility, specifically, in terms of increased responsiveness and efficiency.

The case studies investigate this point and find that two distinct groups of organisations exist. There are those organisations who are driving IOS and those who use the system in a minimalistic way to satisfy trading partner requirements. Organisations driving IOS wish to expand its usage to include as many trading partners as possible, while their potential trading partners are resisting the system. The driving organisation is seeking improvements in internal flexibility

through better responsiveness and efficiency. However their trading partners are providing this flexibility while receiving very little flexibility in return. In such a climate it is taking the driving organisations a considerable number of years to reach critical mass with IOS.

8.5.9 Industry sector

The research also sought to ascertain whether certain industrial sectors gain more organisational flexibility relative to other sectors. No significant difference is found to exist between the degree of flexibility being obtained from IOS and the industry sector in which organisations operate. Hence, it can be concluded that no sector is obtaining higher degrees of organisational flexibility from IOS relative to any other sector.

The case studies show that the focus of IOS can differ across sectors. In one sector IOS are used to improve the payment cycle while in a second sector they are being used to improve procurement. The reason for the contrast is due to the differences in the business drivers of the organisations who are initiating IOS. These drivers are different across value chains and can also be different within the different stages of the same value chain.

8.5.10 Discussion

This research has established that certain organisational factors are related to the degree of flexibility achieved from IOS. Organisations who initiate IOS obtain higher levels of flexibility relative to those who do not. The reason that IOS are initiated is also related to the level of flexibility subsequently achieved. Organisations who adopt IOS for reasons of competitive advantage obtain higher levels of flexibility. On the other hand, organisations whose primary reason for adopting IOS is in response to a trading partner request gain significantly lower levels of flexibility.

The degree of integration of the IOS plan with both the IS and business plans is positively associated with the degree of flexibility gained. Thus, the higher the level of integration between the plans the higher the degree of flexibility being achieved from IOS. Organisations with higher levels of internal IT expertise gain relatively more flexibility from IOS. The degree of IOS integration with existing IS software is positively related to flexibility. Thus, organisations who fully integrate IOS into existing systems obtain higher levels of flexibility. The length of time that an organisation has been using IOS is positively related to flexibility. The major gains in flexibility over time are internal rather than external to the organisation. Organisations who operate in competitive environments are significantly more likely to gain higher levels of flexibility from IOS. On the other hand, traits such as organisational size and the sector in which an organisation operates are found to be unrelated to the extent of flexibility being gained from IOS.

8.6 Limitations of the study

The research strategy employed for this study is pluralistic, consisting of a postal survey and case studies. A major limitation of adopting this approach is that there is little documented evidence of the use of such a strategy (Gable, 1994). Indeed, Smithson (1991) questions the appropriateness of combining positivist and interpretative approaches. In addition there is also debate over which research methods are amenable to the pluralistic approach and in what order they should be combined (Gable, 1994). However, allowing for such arguments the researcher believes that the methods chosen are appropriate for the research undertaken here. This is because the study was exploratory in nature. The postal survey method was used first because it provides the ability to look at a far greater number of variables (Galliers, 1992). Then case studies were undertaken to provide a more in-depth understanding of the propositions supported by the case study research (Bonoma, 1985).

Limitations exist with regard to survey questionnaires in that the design of the questionnaire can have a major effect on survey results. The manner in which questions are phrased, and the order in which they are asked, can affect the answer the respondent provides (Hufnagel and Conca, 1994). Postal questionnaires suffer from the added limitation that respondents may misinterpret or misunderstand questions. This limitation may have influenced the results in this study given that flexibility, the concept being studied, is ubiquitous (Evans, 1991). Attempts were made to minimise this limitation by carrying out pre-tests of the questionnaire in order to remove ambiguities.

A further limitation of a postal questionnaire is that the researcher cannot control who fills out the questionnaire. The study tried to control this limitation by addressing each questionnaire to the IS or IT manager responsible for IOS within the organisation. In addition, each questionnaire was accompanied by a letter addressed personally to the intended respondent.

The sampling frame for this research was purposive rather than a random sample. Adoption of such a sampling frame has been criticised by Kraemer and Dutton (1991). They argue that there is a need to have a random sample if the results are to be truly generalisable. It is acknowledged that using a purposive sample has limitations. However, the study sought to construct a sample which would allow, particularly in the context of exploratory research, conclusions to be drawn which would form the basis for further research.

All survey research suffers from the limitation that it only provides a snap-shot of the situation at a certain time, which yields little information on the underlying meaning of the data (Galliers, 1992). In order to overcome this a pluralistic research approach was undertaken which can reduce the limitations of a specific research method (Greene et al., 1989).

Case study research also has limitations. Specifically, its weaknesses include the lack of generalisability, the potential for bias by the researcher in interpreting the data and the difficulties in distinguishing between cause and effect (Yin, 1984).

Overall, the limitations of the research strategy are a culmination of the limitations of the individual research approaches used in the study. They are inherent within the techniques and are present wherever these techniques are used. While the limitations exist the onus remains with the researcher to counteract these limitations. The adoption of a pluralistic approach allows a greater opportunity to counterbalance the limitations of an individual research method.

The limitations of the research strategy outlined above have consequential implications for the research findings. Primarily, the findings are not generalisable. The results of the survey relate only to those organisations studied, and the case study findings are limited to the specific networks that were investigated. However, given the exploratory nature of the study, the sampling frames chosen were the most appropriate ones available and the limitations are considered acceptable in the circumstances. Furthermore, the findings of the study provide a valuable insight into how flexibility and IOS are connected and can form the basis for further research.

8.7 Further research

This study was exploratory in intent. Given the exploratory nature of the study propositions rather than hypotheses were used to expand the proposed research questions. This study has demonstrated the viability of studying the connection between flexibility and IOS. Further research of an explanatory and confirmatory nature is now required to develop the findings.

The first avenue for further research would be to replicate the study. The replication would facilitate the replacement of propositions by hypotheses. This would be possible because the new study would not be exploratory in nature and thus would be able to formulate hypotheses based on the findings of this study.

Further research is required to refine the findings of this study. This research operationalised flexibility with respect to IOS. Additional research is required to refine this operationalisation. In addition the findings of the study could be refined by extending the number of organisational factors that are considered to influence the flexibility being obtained from IOS.

The findings of this study demonstrate that a relationship exists between IOS and flexibility and that specific organisational factors are related to flexibility. However, the findings do not show the direction of causality. Further research is required to extend this study by exploring the cause and effect relationships between first, IOS and flexibility and second, organisational factors and flexibility. Such a study might be undertaken using longitudinal research (Franz and Robey, 1987). This would provide a more complete understanding of the cause and effect relationships between the different variables.

Further research is also required to extend the findings of this study. The connections between flexibility and IOS found in this study are based on a purposive sample and specific case studies. Thus, there is a need to test the findings on a wider population to increase the generalisability of the findings. Comparative research in another country could be undertaken using the research instruments from this study. Other ways of extending the study are to use an alternative sample and investigate different IOS networks from those researched in this study.

The inclusive definition of flexibility derived in this study could be used to conduct further research into the measurement of flexibility in other information systems. What is required is that such IS be operationalised using the four

dimensions of flexibility which were derived in this study. The operationalisation of flexibility would require the use of the relevant literature on the specific IS as was done for IOS in this study.

8.8 Summary

This study sought to investigate the connection between flexibility and IOS. The research method adopted for this study combines a postal survey and case studies. The use of such a pluralistic method was undertaken to reduce the limitations of using a single research method.

The first part of the study investigates the extent to which the technologies used for IOS provide flexibility. The capacity of IOS technologies to be flexible is mixed. On the one hand there are areas where the technology provides flexibility and other circumstances where it does not. Specifically, IOS technology enables flexibility for foreseeable circumstances, such as adding new trading partners and enabling fast communication. The specific technologies required to run IOS can however reduce flexibility in certain respects. Telecommunications methods, specifically VANS, are inflexible in that incompatibilities exist between the different VANS. Messaging standards are inflexible in that their ability to change rapidly in foreseen circumstances is not as fast as some organisations would like. This inflexibility is more notable due to the multiplicity of different IOS technologies that some organisations are required to support due to preferences of their trading partners.

While the technology may be posing some problems the study finds that organisations are obtaining flexibility from IOS. Specifically IOS are improving the efficiency, responsiveness, versatility and robustness of organisations. These improvements are occurring both within organisations and across the value chain. The degree to which organisations gain flexibility from IOS differs.

Certain characteristics of organisations may account for the different levels of flexibility being attained. Characteristics which have a positive relationship with the level of flexibility include, (i) adopting IOS for offensive competitive reasons, (ii) integrating the IOS plan with the IS plan, (iii) integrating the IOS plan with the business plan, (iv) initiating the adoption of IOS, (v) integrating IOS with other IS software in the organisation, (v) possessing high levels of internal IT expertise, (vi) operating in a competitive environment and (vii) longevity of IOS use. The size of an organisation is not found to be related to the degree of flexibility being achieved. Similarly the industry sector in which an organisation operates is not a good predictor of the extent to which IOS provide flexibility.

In conclusion, this research proposed that a connection exists between flexibility and IOS. The study has proven that such a connection exists. Specifically the study finds first, that IOS technologies have the capability to provide flexibility, second, IOS do provide flexibility for organisations and third, specific organisational factors are related to the extent to which flexibility is being gained from IOS. Having found support for the propositions a need now exists to test them more formally using hypotheses.

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Appendix 1

University College Galway

&

Warwick Business School

Inter-organisational Systems Survey

CONFIDENTIAL

Part I: Inter-organisational Systems (IOS)

1. What types of IOS does your company currently use ? (please tick as appropriate)

1. Electronic Data Interchange (EDI)[1] of business documents	❑
2. Letting a trading partner query your information system or database	❑
3. Query of a trading partners information system or database	❑
4. Transfer of files such as spreadsheet and word processing documents	❑
5. Transfer of files such as engineering drawings	❑
6. Electronic Funds Transfer	❑
7. Financial Information (Cash Management, Bank Reconciliation's)	❑
8. Your Company has a World Wide Web Home Page	❑
9. Internet access to World Wide Web	❑
10. Electronic Mail externally	❑
11. Other (please specify):	

Note: All subsequent questions require that you answer with reference **to one and only one** type of IOS. Thus if your organisation uses more than one type of IOS as identified in question one above, please answer the remainder of the questionnaire in respect of the highest ticked type of IOS on the list which you selected in question one.

2. How long has your organisation been using IOS?

< 1 year	1-2 years	3-4 years	5-6 years	7-8 years	9+ years	Don't know
❑	❑	❑	❑	❑	❑	❑

3. What transmission method do you use to exchange IOS messages? (Please tick as appropriate)

A Value Added Network (VAN)	❑
Direct over telephone network using a modem	❑
Proprietary Network	❑
Others (*please specify):*	

4. What IOS messaging standards does your organisation use? (Please tick as appropriate)

Open messaging standard e.g. EDIFACT, ANSI X12, X400, X435, HTML	❑
In-house proprietary messaging standard	❑
Messaging standard of trading partner	❑
Others (*please specify):*	

[1] EDI is the electronic transfer of commercial or administrative transactions using an agreed standard to structure the transaction or message data from computer to computer

5. Did your organisation initiate the adoption of the IOS system?

Yes	❑	No	❑	Don't Know	❑

6. When your organisation initially adopted the IOS you did so (*please circle a number in each row*)

to speed up the transmission of information	1 2 3 4
to decrease costs	1 2 3 4
to improve productivity	1 2 3 4
to increase the accuracy of the data	1 2 3 4
to facilitate better cash management	1 2 3 4
to gain a competitive advantage	1 2 3 4
to keep up with competitors	1 2 3 4
to improve the level of customer service	1 2 3 4
to enable the offering of an increased product range	1 2 3 4
to increase sales	1 2 3 4
because requested to do so by a trading partner	1 2 3 4
other please specify	1 2 3 4

7. Tick the trading partner with whom your organisation began using the IOS, and the trading partners with whom you currently communicate using the IOS

	Initial Trading Partner	Current Trading Partners
Suppliers	❑	❑
Customers	❑	❑
Financial Institutions	❑	❑
Transportation Companies	❑	❑
Other companies within your Organisation	❑	❑
Distributors	❑	❑
Other (please specify):	❑	❑

8. Please rate your response to the following statements (*please circle a number in each row*)

The degree of IT expertise within your organisation is better than your competitors	1 2 3 4
Previous IT experience within the company helped when designing the IOS	1 2 3 4
There is a low degree of integration between IS planning and IOS planning	1 2 3 4
There is a low degree of integration between IOS planning and business planning	1 2 3 4
Previous IT experience within the company made the implementation of the IOS easier	1 2 3 4
The benefits of the IOS are equally shared between your organisation and your trading partners?	1 2 3 4

If your organisation is currently communicating with only one type of trading partner then please answer question 9, otherwise go to question 10.

9. Your organisation is using an IOS with only one type of trading partner because *(please circle a number in each row)*

Connection of organisations from the initial trading partner group to the IOS is not complete	1 2 3 4 5
It is planned to extend the IOS to additional trading partners in the future	1 2 3 4 5
Currently no reason to connect additional types of trading partners	1 2 3 4 5
Currently not cost effective to connect additional types of trading partners	1 2 3 4 5
Non-compatibility of our messaging standards with those of other types of trading partners	1 2 3 4 5
Non-compatibility of our network service provider(s) with those of other types of trading partners	1 2 3 4 5
Other (please specify):	1 2 3 4 5

10. Approximately what percentage of your organisations transactions are conducted via IOS? *(Please tick one for each item).*

	0%	1-20%	21-40%	41-60%	61-80%	81-100%
Price Catalogue	❑	❑	❑	❑	❑	❑
Purchase Order	❑	❑	❑	❑	❑	❑
Invoice	❑	❑	❑	❑	❑	❑
Sales	❑	❑	❑	❑	❑	❑
Electronic Funds Transfer	❑	❑	❑	❑	❑	❑
Financial Information	❑	❑	❑	❑	❑	❑
Bank Statement	❑	❑	❑	❑	❑	❑
Other (please specify):	❑	❑	❑	❑	❑	❑

11. The following were important when you chose the message format for the IOS messages *(please circle a number in each row)*

Cost Savings	1 2 3 4 5
The availability of an open non-proprietary messaging standard	1 2 3 4 5
Ability to subsequently change the format of the IOS messages	1 2 3 4 5
Trading partner(s) had already decided, and your organisation followed their decision	1 2 3 4 5
Other please specify	1 2 3 4 5

12. The following were important considerations when you choose the telecommunications method for the IOS? *(please circle a number in each row)*

Cost	1 2 3 4 5
Customer service record of the telecommunications service provider	1 2 3 4 5
Ability to connect additional trading partners to the telecommunications infrastructure	1 2 3 4 5
Ability to change telecommunications method if desired	1 2 3 4 5
Trading partner(s) provided the technology and the required telecommunications method	1 2 3 4 5
Other please specify	1 2 3 4 5

13. Our organisation has experienced problems with regard to the IOS due to (*please circle a number in each row*)

Lack of IOS software	1 2 3 4 5
Higher than anticipated development and installation costs	1 2 3 4 5
Incompatibility between the IOS software and other software within the organisation	1 2 3 4 5
The incompatibility of different network service providers	1 2 3 4 5
Other please specify	1 2 3 4 5

14. Since adopting IOS: (*please circle a number in each row*)

the time it takes to transmit documents within the organisation has increased	1 2 3 4 5
lead times between the participating trading partners have decreased	1 2 3 4 5
the ability of your organisation to change in response to requests from trading partners has decreased	1 2 3 4 5
your organisation has been able to provide increased levels of service to your trading partners	1 2 3 4 5
your organisations responsiveness to the market has increased	1 2 3 4 5
communications between your organisation and its trading partners has dis-improved	1 2 3 4 5
your organisation has become more closely associated with your trading partners	1 2 3 4 5
the internal information for decision making within your organisation has improved	1 2 3 4 5
your company has been able to offer a wider product range	1 2 3 4 5
the overall performance of your organisation has decreased	1 2 3 4 5
your organisation has been able to adapt more easily to changes in the marketplace	1 2 3 4 5
the amount outsourced to trading partners has decreased	1 2 3 4 5
your organisation has been able to diversify into new markets	1 2 3 4 5

15. The use of the IOS has : (*please circle a number in each row*)

resulted in fewer out-of-stock occurrences	1 2 3 4 5
enabled the organisation to adopt a more flexible buying strategy	1 2 3 4 5
decreased the organisation's inventory costs	1 2 3 4 5
increased the cost of data re-entry	1 2 3 4 5
decreased the document transmission costs between your organisation and your trading partners	1 2 3 4 5
brought about an increase in labour costs	1 2 3 4 5
improved the accuracy of the data entering your computer systems	1 2 3 4 5
enabled your organisation to exert more control over the transport and distribution of goods	1 2 3 4 5
increased the financial exposure of your organisation to your trading partners	1 2 3 4 5
improved your organisation's cash-flow	1 2 3 4 5
restricted the organisation's ability to adapt business strategies in response to changing business requirements	1 2 3 4 5
improved the quality of internal information resources	1 2 3 4 5

16. Do you believe that the IOS will restrict your organisation's ability to adapt to changing business requirements in the future?

Yes	❑	No	❑	Don't Know	❑

If yes, how do you believe it will restrict your ability to adopt?
If no, why do you believe it will not restrict your ability to adopt?

_____
_____
_____
_____
_____

17. Which of the following **best** describes your IOS? (Please tick **one** only)

The IOS software resides on a stand-alone Personal Computer	❑
The IOS software is connected to the main computing systems via an uploading/downloading process which eliminates the need to re-key the information received	❑
The IOS software is seamlessly integrated with production applications such as purchasing, order entry, production scheduling, inventory management, accounts receivable/payable, shipping and so on.	❑

18. The use of the IOS has : (*please circle a number in each row*)

decreased the time taken to complete a business transaction	1 2 3 4 5
increased the need for intermediary organisations' such as distributors or wholesalers	1 2 3 4 5
facilitated a reduction in the total number of trading partners with whom your organisation trades.	1 2 3 4 5
made it harder for your organisation to expand its trading network	1 2 3 4 5
increased your organisation's ability to reposition itself in its marketplace	1 2 3 4 5
decreased your organisation's ability to change its organisational strategy	1 2 3 4 5
provided your organisation with a source of competitive advantage	1 2 3 4 5
decreased your organisation's ability to react to unforeseen circumstances	1 2 3 4 5

19. IOS messaging standards: (*please circle a number in each row*)

are adaptable	1 2 3 4 5
reduce the ability of organisations to adopt new business processes	1 2 3 4 5
can be changed rapidly in response to unforeseen circumstances	1 2 3 4 5
enable your organisation to communicate easily with your trading partners	1 2 3 4 5
usage allows your organisation to begin communicating electronically with a new trading partner easily	1 2 3 4 5

Part II: Other Information

20. What is the approximate **total** number of full-time employees in your organisation? ☐

21. What was your organisation's approximate annual turnover or total budget (if public sector organisation) during the last financial year? £ ☐

22. Which of the following best describes the sector in which your organisation operates? (please tick one only)

Banking	❑
Insurance	❑
Retailing	❑
Public Sector	❑
Manufacturing / Production	❑
Transportation	❑
Wholesaling / Distribution	❑
Services	❑
Other (please specify):	

23. Your organisation operates in an environment: (*please circle a number in each row*)

that requires a high degree of diversity in marketing	1 2 3 4 5
that requires a high degree of diversity in production	1 2 3 4 5
in which customers' tastes change rapidly	1 2 3 4 5
in which competitors' actions are highly unpredictable	1 2 3 4 5
of intense competition	1 2 3 4 5

24. Would your like a copy of the results of this survey?

Yes	❑	No	❑

25. Would your organisation be willing to participate further in this study?
(This would involve a personal interview)

Yes	❑	No	❑

Details of the person who filled out this questionnaire

Name	
Position	
Company Address	
Telephone Number	

If you wish to make any comments on this survey or on how you believe IOS affects your organisations flexibility, please feel free to do so

Thank you for your time and co-operation

UCG

Department of Accountancy & Finance,
University College Galway, Ireland.

Tel: 091 750301 (Direct)
091 524411 (Switchboard)
Fax: 091 524130

Dear ....

I know what you are thinking: Not another questionnaire !!!!

Does this questionnaire deserve to be answered you ask? I would propose that it does, but then I would - I put months of work into its preparation.

I am a lecturer in information systems at University College Galway and I am currently studying for a doctorate in information systems at the University of Warwick. The purpose of this survey is to find out how computer systems linking different organisations affect the flexibility of those organisations.

You have been identified as a person with working experience and knowledge of the topic. The survey will take approximately 10 minutes of your time. In an effort to simplify answering, 95% of the questions are of a form which requires you to tick a box, or circle a number. In addition I have enclosed a self addressed envelope which will enable you to send back the completed questionnaire easily.

As a token of my appreciation for your participation, I would be very pleased to send you a summary of the research findings if you so wish.

The success of the project depends on getting a high response rate. To this end, I would be very grateful if you would return the questionnaire sent to you as part of this study, at your earliest convenience. Sending back a completed questionnaire will play an important part in helping me to complete my doctoral studies.

Thanking you in anticipation of your assistance.

Yours sincerely

William Golden
Lecturer in Information Systems

UCG

Department of Accountancy & Finance,
University College Galway, Ireland.

Tel: 091 750301 (Direct)
091 524411 (Switchboard)
Fax: 091 524130

16 August 1996

Dear

Last month I sent you a questionnaire relating to how computer systems linking different organisations affect the flexibility of those organisations.

I am conducting this survey as part of my studies for a doctorate in information systems at the University of Warwick. The success of my doctoral studies depends on my getting a high response rate to this questionnaire.

I have enclosed a second copy of the questionnaire and I would very much appreciate your co-operation in completing it. It will take 10 minutes of your time to fill out - most of the questions are of a form which requires you to tick a box, or circle a number.

I would be very, very grateful if you would return the questionnaire at your earliest convenience. The higher the response rate, the greater the validity of my research - for this reason your opinions are very important.

As a token of my appreciation for your participation, I would be very pleased to send you a summary of the research findings if you so wish.

Thanking you in anticipation of your help.

Yours sincerely

William Golden
Lecturer in Information Systems

Appendix 2

INTER-ORGANISATIONAL INFORMATION SYSTEMS IN IRELAND

Highlights

Higher levels of organisational flexibility [i] as a result of using an interorganisational information system (IOS)[ii] are being achieved by organisations who:

- initiate the adoption of the IOS
- integrate the IOS software with existing information systems
- have experienced IT personnel within the firm
- have been using the IOS for longer
- operate in volatile markets
- are larger in terms of turnover

Significant differences exist between initiators and non-initiators of an IOS

- Initiators believe that the benefits of the IOS are shared equally while non-initiators believe that they are not.
- Initiators conduct significantly higher percentages of their transactions using the IOS relative to non-initiators.

CONDUCTED BY
WILLIAM GOLDEN,
LECTURER IN MIS,
UNIVERSITY COLLEGE GALWAY
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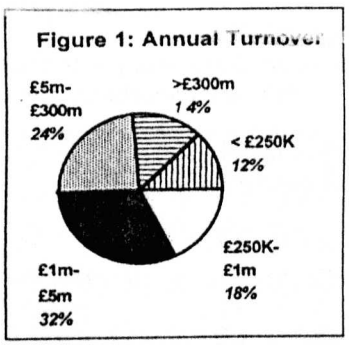
Profile of organisations who responded

150 organisations filled in the questionnaire from the study[iii]. The profile of these organisations is outlined in Figures one to four.



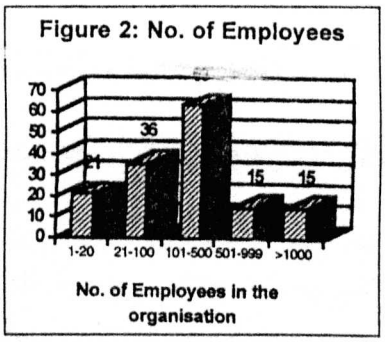
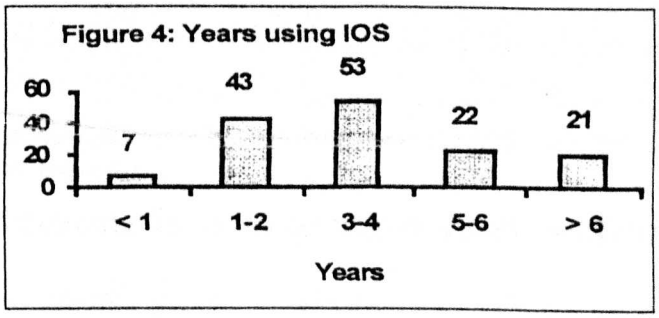


Figure 3: Business Sector	*%*
Manufacturing & Production	54
Wholesaling & Distribution	19
Services	7
Public Sector	5
Retailing	4
Banking & Insurance	4
Others	7



Electronic data interchange[iv] with 80% of organisations using it, was the predominant type of IOS. Other types of IOS's in use included systems that facilitated the transfer of files, and systems that allowed interorganisational database queries.

Trading Partners with whom the IOS is used

Customers were the most common initial trading partner for an IOS (see Figure 5). Some organisations began using their IOS initially with more than one trading partner.

Figure 5: Percentage of total number of lorganisations who use an IOS to trade with each type of trading partner

Types of Trading Partners	*Initial Trading Partner(s)* %	*Current Trading Partners* %
Customers	54%	38%
Suppliers	14%	17%
Financial Institutions	14%	17%
Other companies within your Organisation	12%	14%
Transportation Companies	3%	7%
Distributors	2%	6%
Others	1%	1%

- 59% of organisations were communicating with only one type of trading partner. Most intended to extend the IOS to include additional trading partners in the future.
- Reasons preventing organisations trading with more than their initial trading partner included :
  not enough resources available
  the addition of other types of trading partners not a priority
- The non-compatibility of network service providers was seen by only 10% of organisations as a reason which was preventing them connecting to additional types of trading partners.

Types of transactions conducted via IOS

Figure 6 lists the types of transactions being conducted via an IOS in descending order of usage, indicating that invoices are the most commonly exchanged document with 60% of organisations exchanging them.
The majority of organisations were sending less than 41% of their total volume of each business document electronically (See Figure 6).

Figure 6: Number of organisations using each type of transaction and the percentage of the organisations total volume being conducted via IOS

	No.of Companies	1-20%	21-40%	41-60%	61-80%	81-100%
Invoice	92	43%	22%	13%	16%	6%
Electronic Funds Transfer	74	41%	19%	9%	20%	11%
Financial Information	54	41%	20%	9%	22%	8%
Purchase Order	53	42%	17%	13%	19%	9%
Price Catalogue	51	47%	23%	12%	14%	4%
Sales	48	42%	21%	23%	12%	2%
Bank Statement	46	33%	6%	9%	9%	43%

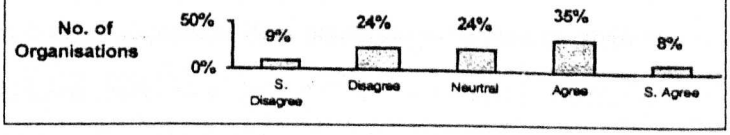
● Organisations who send significantly more documents electronically have been using the IOS for longer and operate in a competitive environment which changes frequently.

Degree to which the IOS software is integrated with other IS

✔ 36% of organisations' IOS software resides on a stand-alone personal computer.
✔ 43% have integrated the IOS with their IS to the extent that electronic uploading and downloading was possible and thus the need to re-key data has been eliminated.
✔ 21% have seamlessly integrated the software with their other IS.

The difficulties being caused by the lack of software compatibility between the IOS software and the IS software are considerable.
43% of organisations experienced problems with the integration of their IOS software with existing IS (Figure 7).

Figure 7: Your organisation has experienced problems due to the incompatibility between the IOS software and existing internal IS



Reasons for Adopting IOS

The most important reason for adopting the IOS was a desire to improve the level of customer service, followed by the desire to speed up information transmission (See Figure 8). On further analysis it was discovered that the reasons for adopting an IOS differed significantly depending on whether or not the organisation initiated the new information system. Specifically for the non IOS initiating organisation the overwhelming reason for adoption was because they were requested to do so by a trading partner (See Figure 8).

Figure 8: Reason for initial adoption of IOS

(questions were asked on a scale of 1-5 with 1 = to strongly disagree and 5 = strongly agree)	Rank and Mean of all organisations who responded		Rank and Mean of Initiating Organisation		Rank and Mean of Non-Initiating Organisation	
improve the level of customer service	1	4.12	2	4.15	2	4.11
speed up information transmission	2	3.95	1	4.17	4	3.70
requested by a trading partner	3	3.73	9	2.75	1	4.56
improve productivity	4	3.69	3	4.05	7	3.29
keep up with competitors	5	3.61	7	3.48	3	3.74
increase the accuracy of the data	6	3.56	5	3.75	5	3.37
gain a competitive advantage	7	3.55	4	3.80	6	3.30
decrease costs	8	3.08	6	3.49	10	2.65
facilitate better cash management	9	3.04	8	3.32	8	2.79
increase sales	10	2.69	10	2.70	9	2.68
enable the offering of a greater product range	11	2.45	11	2.60	11	2.31

Messaging Standards

Organisations in general appear content with the messaging standards available.

- 78% of organisations use open messaging standards (EDIFACT, ANSI X12, X400, and X435)
- 47% believe that when choosing the message format, the availability of an open non-proprietary messaging standard was important, while 21% felt that it was not an important consideration.
- 69% believe that messaging standards enable them to communicate easily with their existing trading partners, while 10% believe they do not
- 65% believe that the messaging standards allow them to begin communicating electronically with a new trading partner easily, while 14% believe they do not.
- The non-compatibility of messaging standards was not a major factor in preventing those organisations who had not expanded the use of IOS to additional types of trading partners with only 11% believing it had pre vented them from doing so.
- Only 6% of organisations believe that the IOS messaging standard reduces their ability to adopt new business processes. The majority, 62%, believe that IOS messaging standards have no such effect.

Concern exists about the flexibility of the messaging standards, especially with respect to unforeseen circumstances

- 21% believe that messaging standards are not adaptable.
- 43% believe that the messaging standards cannot change in response to unforeseen circumstances, while 20% believe they can.

Network Service Providers

38% of organisations have experienced problems due to the incompatibility of different network service providers.

Does an IOS affect the ability of an organisation to adapt to changing business requirements?

Only 3% of respondents were of the belief that their IOS would restrict their organisations ability to adapt to changing business requirements.
80% believed that it would not restrict their organisations ability to adapt and 17% did not know whether it would or not.

Planning

Organisations who integrated their IOS plan into their IS plan obtained increased levels of organisational flexibility from the IOS. Higher levels of integration between the two plans resulted in improved internal information for decision making, decreased labour costs, decreased lead times between themselves and their trading partners, and an increased ability to change organisational strategy and respond to unforeseen circumstances.
Those organisations who had a low level of integration between the IS and IOS plans were significantly more likely to experience software integration problems between the IOS software and other software.

A higher degree of integration between the IOS and business plans brought about increased levels of organisational flexibility in the forms of improved levels of service to trading partners, an improvement in the quality of internal information for decision making and an ability to offer a wider product range.

Footnotes

i Organisational flexibility was operationalised by asking 33 different questions which measured the degree to which the IOS had effected the responsiveness, versatility, efficiency, resilience and robustness of the organisation.
ii For the purposes of the survey an inter-organisational system (IOS) was defined as a computer based information system that facilitates the exchange of information electronically using telecommunications between different organisation's computer systems.
iii The mail based survey was administered during July and August 1996.
In carrying out the research a list of 338 organisations engaged in using IOS's was compiled and a response rate of 44.5% was achieved.
89% of respondents held management positions, 47% being IS/IT managers. The remaining 11% of respondents did not fill in their job description.
iv For the purposes of the survey EDI was defined as the electronic transfer of commercial or administrative transactions using an agreed standard to structure the transaction or message data from computer to computer.

Appendix 3

Non-response bias test

Questions 14 and 15

	Significance Level
the time it takes to transmit documents within the organisation has increased	.7296
lead times between the participating trading partners have decreased	.5216
the ability of your organisation to change in response to requests from trading partners has decreased	.5038
your organisation has been able to provide increased levels of service to your trading partners	.7045
your organisations responsiveness to the market has increased	.5135
communications between your organisation and its trading partners has dis-improved	.1931
your organisation has become more closely associated with your trading partners	.3583
the internal information for decision making within your organisation has improved	.4670
your company has been able to offer a wider product range	.5665
the overall performance of your organisation has decreased	.5837
your organisation has been able to adapt more easily to changes in the marketplace	.8094
the amount outsourced to trading partners has decreased	.2393
your organisation has been able to diversify into new markets	.1704

Question 15. The use of the IOS has :

resulted in fewer out-of-stock occurrences	.4923
enabled the organisation to adopt a more flexible buying strategy	.5245
decreased the organisation's inventory costs	.4801
increased the cost of data re-entry	.2187
decreased the document transmission costs between your organisation and your trading partners	.3080
brought about an increase in labour costs	.2120
improved the accuracy of the data entering your computer systems	.9799
enabled your organisation to exert more control over the transport and distribution of goods	.4760
increased the financial exposure of your organisation to your trading partners	.8887
improved your organisation's cash-flow	.7358
restricted the organisation's ability to adapt business strategies in response to changing business requirements	.3725
improved the quality of internal information resources	.2820

Question 18. The use of the IOS has

decreased the time taken to complete a business transaction	.5295
increased the need for intermediary organisations' such as distributors or wholesalers	.8654
facilitated a reduction in the total number of trading partners with whom your organisation trades.	.3481
made it harder for your organisation to expand its trading network	.6292
increased your organisation's ability to reposition itself in its marketplace	.2914
decreased your organisation's ability to change its organisational strategy	.8218
provided your organisation with a source of competitive advantage	.8330
decreased your organisation's ability to react to unforeseen circumstances	.9833

Appendix 4

General questions arising out of the questionnaire

Which of your IOS do you consider the most important ?
Why?

Who are the main trading partners that you are connected to via IOS ?

What were the main reasons for adopting the system ?

Was a desire to create more flexible processes one of the initial reasons that you adopted IOS ?

Technological flexibility of IOS

Degree of IOS software integration with other IS
- If not fully integrated why not ?
- If fully integrated what benefits does it give ?

Do you feel that the technology you use for IOS constrains you ?
- technological obsolescence
- messaging standards
- network chosen

How important was technological flexibility when you adopted IOS ?

From my research organisations believe that IOS will not restrict an organisation's ability to adapt to changing business requirements in the future, why do you think this is so ?

Organisational flexibility

How important is creating flexible systems \ procedures to your organisation ?

How does the organisation try to achieve it ?

Does the organisation try to measure the degree of flexibility it has ?

Do you think that the need to be flexible will become more important in the future ?

How do you think your organisation rates as regards flexibility compared to
- direct competitors
- other organisations

How does IOS fit with the business objectives of your organisation?

Has it made the organisation more flexible ?

Has it made the organisation less flexible ?

Do you think your organisation is getting the most from IOS?

Flexibility of the value chain

Do you think the benefits are shared equally between you and your trading partners ?

How do you think IOS affects the complete value chain ?

(Prompt)

shorten the value chain by eliminating intermediaries
enables outsourcing and focusing on core competencies

Do you think it makes the complete value chain more flexible ?

Appendix 5

Factor	1	2	3	4	5	6
Flexibility Questions	Inventory Manage-ment	Organisa-tional Adaptabil-ity	Market Manage-ment	Trade Rela-tions	Internal Data Costs	Info. Provi sion
Efficiency						
resulted in fewer out-of-stock occurrences	.80					
adopt a more flexible buying strategy	.79					
inventory costs	.77					
data re-entry costs					.72	
decreased the document transmission costs				.51		
labour costs					.74	
accuracy of the data entering your computer systems				.48		
more control over the transport and distribution of goods	.65					
the financial exposure to your trading partners						.42
organisation's cash-flow				.61		
ability to adapt business strategies in response to changing business requirements		.63				
the quality of internal information resources						.62
Responsiveness						
time it takes to transmit documents					.62	
lead times between the participating trading partners				.56		
ability to change in response to requests from trading partners		.60				
levels of service to your trading partners				.56		
responsiveness to the market			.62			
communications with trading partners		.72				
more closely associated with your trading partners				.48		
internal information for decision making						.67

Factor	1	2	3	4	5	6
Flexibility Questions	Inventory Manage-ment	Organisa-tional Adaptabil-ity	Market Manage-ment	Trade Rela-tions	Internal Data Costs	Info. Provi sion
Versatility						
company has been able to offer a wider product range			.73			
overall performance of your organisation		.53				
adapt more easily to changes in the marketplace			.66			
amount outsourced to trading partners			.35			
diversify into new markets			.68			
Robustness						
the time taken to complete a business transaction				.66		
the need for intermediary organisations'		.49				
total number of trading partners with whom your organisation trades.		.49				
expand its trading network		.46				
reposition organisation in its marketplace			.74			
change its organisational strategy		.61				
a source of competitive advantage			.44			
ability to react to unforeseen circumstances		.71				

Appendix 6

Retail Grocery Organisation

This company operates in the wholesaling /distribution sector. It has an annual turnover of £800 million. It currently employs 1,500 full-time staff. IOS has been implemented in this company for 5-6 years. The company initiated the adoption of IOS. They began using the system to communicate with suppliers and have not extended its use to additional types of trading partners.

IOS types used in this company are; (i) EDI of business documents, (ii) Electronic Funds Transfer, (iii) financial information, (iv) internet access to WWW, and (v) electronic mail externally. Purchase orders and sales are not conducted via the IOS. 1-20% of the company's price cataloguing and financial information is carried out via the IOS. 21-40% of the company's electronic funds transfer transactions are carried out via the IOS. Whereas 61-80% of invoices and bank statements transactions are conducted via the IOS.

Processed Food Supplier

This company currently has a turnover of £45 million. It currently employs 95 full-time staff. It operates in the retailing sector. This company has been using IOS for three to four years. The company did not initiate IOS and adopted them due to a customer request. IOS types being used are: (i) EDI of business documents, (ii) letting a partner query their information system or database, as well as for the (iii) transfer of files such as spread sheets and word processing documents.

This company began using the IOS with customers. The trading partners have now been increased and IOS enables the company to communicate with customers financial institutions, other companies within the organisation as well as with distributors. IOS is not used in this company for purchase orders, for financial

information or for bank statements. However 1-20% of this company's Electronic Funds Transfer transactions are conducted via IOS. 21-40% of the company's price catalogue and invoices are conducted via IOS implemented in the company. 61-80% of the company's sales are also conducted via IOS

Dairy Supplier

This company currently has a turnover of £500 million. It currently employs 2,500 full-time staff. It operates in the manufacturing / production sector. The company has been using IOS for three to four years. The introduction of IOS came about due to a customer request and was not initiated by the company. The IOS types being used are: (i) EDI of business documents, (ii) query of a trading partners information system or database, (iii) transfer of files such as spread sheets and word processing documents, (iv) Electronic Funds Transfer, (v) internet access to WWW, and (vi) external electronic mail. The company also has its own WWW Home Page.

This company began using IOS with customers and financial institutions and it is still currently communicating with both these trading partners. IOS are not used in this company for purchase orders or for financial information. However 1-20% of this company's Electronic Funds Transfer, invoices and price catalogue transactions are conducted via IOS.

Packaging Supplier

This company currently has a turnover of £1.8 million. It currently employs 11 full-time staff. It operates in the wholesaling / distribution sector. This company has been using IOS for between one and two years. The introduction of IOS into the company was not initiated by the company itself. The types of IOS being used are (i) EDI of

business documents and (ii) electronic mail. This company began using IOS with customers and has not extended its usage to additional types of trading partners.

Sportswear Supplier

This company currently has a turnover of £9 million. It currently employs 350 full-time staff. It operates in the manufacturing / production sector. IOS have been in use in the company for seven to eight years. The introduction of IOS into the company was not initiated by the company itself, but instead resulted from a customer request. The different types of IOS in use are: (i) EDI of business documents, (ii) transfer of files such as spread sheets and word processing documents, (iii) transfer of files such as engineering drawings, (iv) internet access to the WWW, (v) and for external electronic mail. The company also has its own WWW Home Page.

The use of IOS has been widened to include customers, distributors and transportation companies. IOS is not used in this company for price cataloguing, for purchase orders, for financial information or for bank statements. However 1-20% of this company's Electronic Funds Transfer transactions are conducted via IOS. 41-60% of the company's sales are conducted via IOS. Whereas, 61-80% of the company's invoices are dealt with via IOS implemented in the company.

Socks Supplier

This company currently has a turnover of £10 million. It currently employs 250 full-time staff. It operates in the manufacturing / production sector. The company has been using IOS for three to four years. The introduction of IOS into the company came as a result of a customer request and was not initiated by the company itself. The IOS types currently in use are: (i) EDI of business documents, (ii) transfer of files such as spread sheets and word processing documents, (iii) transfer of files such as engineering drawings, (iv) Internet access to WWW, and (v) external electronic mail.

This company began using the IOS with suppliers and customers and it is still currently communicating with both these trading partners as well as transportation companies. IOS are not used in this company for price cataloguing, electronic funds transfer, financial information or for bank statements. However 1-20% of the company's purchase orders and invoices are conducted via IOS. 21-40% of the company's sales transactions are also conducted via IOS.

Grocery Packaging Supplier

This company currently operates in the manufacturing / production sector. It has a turnover of £13 million and employs 105 full-time staff. The company has been using IOS for 1-2 years. The company did not initiate the adoption of IOS. Their initial trading partner with whom they currently communicate with via IOS are customers.

The IOS which is in use in the company has a variety of uses. The company uses it for (i) EDI of business documents, (ii) transfer of files such as engineering drawings, (iii) Electronic funds Transfer, (iv) internet access to WWW, and (v) for external electronic mail. Price cataloguing, purchase orders, invoices, and bank statement transactions are not conducted via IOS in this company. However, 1-20% of the company's sales, electronic funds transfer and financial information are conducted via IOS

Technology Manufacturer

This company currently has a turnover of $ 8 billion. It currently employs 57,000 full-time staff. It operates in the manufacturing / production sector. This company has been using IOS for over nine years. IOS were introduced into the company to fulfil a customer request. The main types of IOS used are: (i) EDI of business

documents, (ii) transfer of files such as spread sheets and word processing documents, (iii) transfer of files such as engineering drawings, (iv) Electronic Funds Transfer, (v) financial information, (vi) internet access to the WWW, and (vii) electronic mail. The company also has its own WWW Home Page.

This company began using the IOS with customers. The company currently communicates with suppliers, financial institutions, transportation companies and distributors via IOS. IOS are not used in this company for price cataloguing, for invoices, or for bank statements. However 1-20% of this company's financial information is obtained via IOS. 21-40% of the company's electronic funds transfer transactions are conducted via IOS. 61-80% of the company's purchase orders and forecasts are conducted via IOS. 81-100% of the company's sales are conducted via IOS.

Telecoms Manufacturer

This company currently has a turnover of £12 million. It employs 64 full-time staff. It operates in the manufacturing sector. The company has been using IOS for three to four years. The company did not initiate the use of IOS. Initially the system was set up to communicate with customers. IOS are currently used to communicate with suppliers, customers, financial institutions and other companies within the organisation.
The main types of IOS in use are: (i) EDI of business documents, (ii) transfer of files such as spread sheets and word processing documents, , (iii) internet access to the WWW, and (iv) electronic mail. The company also has its own WWW Home Page.

Specialist Packaging Supplier

This company currently has a turnover of £4.5 million. It employs 26 full-time staff. It operates in the manufacturing sector. The company has been using IOS for one to two

years. The company did not initiate the use of IOS. Initially the system was set up to communicate with customers. IOS are currently used to communicate with suppliers and customers.

The main types of IOS in use are: (i) EDI of business documents, (ii) transfer of files such as spread sheets and word processing documents, , (iii) transfer of engineering files, and (iv) electronic mail. The company also has its own WWW Home Page. IOS are used to send 1-20% of purchase orders, 1-20% of invoices. IOS are also used to receive financial information.