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ABSTRACT

The growing importance of Electronic Data Interchange for the rapid transmission of intra- and inter-organizational communications is becoming widely recognized. EDI itself is little more than a faster mail service: it is the opportunity to integrate EDI with internal application systems and organizational functions which separates it from other forms of electronic telecommunications — and makes EDI a truly strategic application, offering comparative advantage at the organizational, national and international levels.

This paper discusses the results of a series of case studies of Australian organizations involved with EDI, undertaken to determine whether integration with internal application systems can be defined as a series of comparatively standard and recurring stages. The results of the analysis indicate that while such integration does, indeed, occur in a relatively standard manner for a large class of EDI-using organizations, there are also three other classes of organization for each of which a different model is appropriate. Although these additional classes are small in terms of the number of organizations of which they are composed, they are significant in terms of their importance and influence on industry in general and on EDI penetration in particular.

1. INTRODUCTION

1.1 EDI: A Cooperative Inter-Organizational System

"An examination of the strategic use of information systems technology by business organizations shows that the most dramatic and influential contemporary uses involve systems that transcend company boundaries" (Cash 1985, p. 200).

The concept of multi-organizational information systems is not a new one: corporate cash management systems have been used daily by large (and increasingly by small) companies for a number of years now, while on-line reservation systems have been so successful as to provoke a number of crises in the U.S. airline industry. Despite the popularity of such special cases, inter-organizational information systems have only recently begun to attract wide-spread general interest, in some degree due to the dramatic growth of that particular type of inter-organizational system known as Electronic Data Interchange (EDI).

EDI, "the standards-based computer-to-computer exchange of intercompany business documents and information" (Coathup 1988), gains its attractiveness from the promise of major cost savings in inter-company transaction costs and greatly increased productivity. EDI is already seen as an essential prerequisite for Just-in-Time/Quick Response inventory and production systems (Robinson and Stanton 1987; Sadhwani and Sarhan 1987; Knill 1989; Skagen 1989). Inter-connections are now being urged between EDI and other types of information systems, such as electronic funds transfer (EFT) systems (Canright 1988; Cafiero 1989) and corporate application systems (Svinicki 1988; Wilmot 1988), to provide additional organizational efficiency.

In 1982 the Society for Information Management, together with the University of Arizona, funded research on inter-organizational systems (IOS). The study was undertaken by Barrett and Konsynski (1982) and the original material further developed in papers by Cash and Konsynski (1985) and Cash (1985). These authors suggest potential strategic uses of such systems (overall cost leadership, product differentiation and special market focus) and point to the influence on industry structure which may be exerted by inter-organizational systems — such as to change the balance of power in buyer-seller relationships or to enable a group of organizations to unite within a common set of standards/protocols which may result in the establishment of barriers to entry or exit within a particular market-place (see also Porter and

Millar 1985; Copeland and McKenney 1988; Reich and Benbasat 1990; Wiseman 1989).

EDI is merely a special type of IOS, dealing with the transfer of **standard-format** business documents. Mc-Nurlin (1987), however, also suggests that EDI is the definitive example of a **cooperative** IOS (seen in EDI's adoption by such fiercely competitive market sectors as the automotive and pharmaceutical industries) and concludes that organizations view EDI as a factor in their industry's survival, rather than a competitive weapon. Short-term competitive advantage from EDI is possible for an organization which is the first in its market sector to link in suppliers — but only until a competitor follows suit: "EDI applications, rather than being a competitive weapon, are increasingly a necessary way of doing business" (Benjamin, De Long and Scott Morton 1990, p. 29).

1.2 Integration with Internal Application Systems

The long-term strategic importance of EDI lies in the potential **comparative** advantage to be gained from its use:

> those who do gain significant competitive advantage from EDI will do so by learning how to integrate the technology effectively into their organizations in such a way that they can continually add valuable new capabilities to the system, while deriving cost savings from increased productivity and decreased overhead made possible by EDI. (Benjamin, De Long and Scott Morton 1990, p. 39)

EDI in its simplest form (as a replacement for paper-based document flows) is little more than a rapid electronic mail service. Significant changes only occur with the integration of EDI into internal application systems, allowing a seamless connection to functions such as purchasing, order entry, shipping, inventory management and accounts payable and receivable (Boucher 1989).

Figure 1 shows that EDI software performs two quite disparate tasks — and thus can be sub-divided into two separate categories:

- in-house interface software, which translates outgoing information from unstructured, company-specific formats into structured EDI formats (such as ANSI X12 or EDIFACT) and places these structured documents in an electronic "out-tray" (and, of course, deals with incoming structured documents in an analogous manner); and

- network communications software, which transmits the now structured message to its recipient (using data communications standards such as OSI). For an extended discussion of this topic, see Swatman, Swatman and Duke (1991).

While many prospective EDI-purchasing organizations concentrate their attention on the communications software (which is generally provided by third-party network suppliers in any case), it is in the domain of the in-house interface software that the greatest potential for strategic benefit in the form of comparative advantage may be found.

Linking EDI messages with in-house systems can improve an organization's internal operations — reducing or eliminating administrative overhead such as overtime premiums, overnight courier charges, late/incorrect shipments from suppliers, excess inventories, poor forecasting, disruptive production schedules and incorrect order entry (Skagen 1989).

1.3 Integration with Overall Business Practice

The benefits offered by internal systems integration are significant in themselves, but still more significant long-term benefits will be built upon the technical foundation provided by system integration. These strategic gains arise through changes in the organization's structure and functions, so that EDI provides the spring-board for re-designed, efficient work and production practices. Such beneficial integration is consistent with the Benson and Parker (1985) Enterprise-wide Information Management (EwIM) model.

This view is supported by the existing European experience: "I suggest you look particularly hard at intra-company activity, and look beyond purely paperless trading for the early international paybacks...the most successful users of EDI don't mind joining industry clubs and sharing the benefits of intercompany EDI, because they have usually got massive organizational restructuring and internal information systems plans to exploit the situation competitively" (Wilmot 1988, p. 17).

As a particular example, the need for total integration is well recognized in the retail industry, where Quick Response (QR) systems depend for their success on connectivity.

> Every stage in the retail chain, from production to sales, must be able to link in to achieve the turnaround and productivity improvements sought....To get

maximum benefit from EDI, an order must flow right through a vendor's system, right to the distribution centre, without being re-entered or manipulated manually. (Spriggs 1989, p. 28).

2. EDI INTEGRATION IN PRACTICE — THE STUDY

2.1 The Background to the Study

The major problems associated with involvement in EDI are not primarily technical in nature, but may rather be the result of inefficiencies in corporate information systems analysis and design — or, alternatively, might result from a lack of top-level management support (Swatman and Clarke 1991; and further developed in Swatman and Swatman 1991a). This, in turn, implies that the broad organizational integration and re-evaluation of structure and function which Benjamin, De Long and Scott Morton (1990) and Wilmot (1988) regard as essential for strategic gains may also be affected.

It has now become almost an article of faith within the EDI community to claim that "EDI is 90% business and 10% technology." A wide variety of writers within both the trade and academic sectors provide support for the view that EDI should be regarded as a strategic issue, rather than as a technical problem (see, for example, Sadwani and Sarhan 1987; Robinson and Stanton 1987; Patrick 1988; Lyttle 1988; Skagen 1989; Rochester 1989; Emmelhainz 1990; Swatman and Swatman 1991a; 1991b; 1991c).

The failure to validate this view is largely due to the difficulties of separating EDI's technical aspects from the organizational issues of implementation and integration. Prospective users of EDI have tended to view both aspects of the total EDI system as falling within the domain of their own IS department and, since the creation of an EDI communications system is unquestionably a complex and difficult task, it is not surprising that they have recoiled from contemplation of the issues.
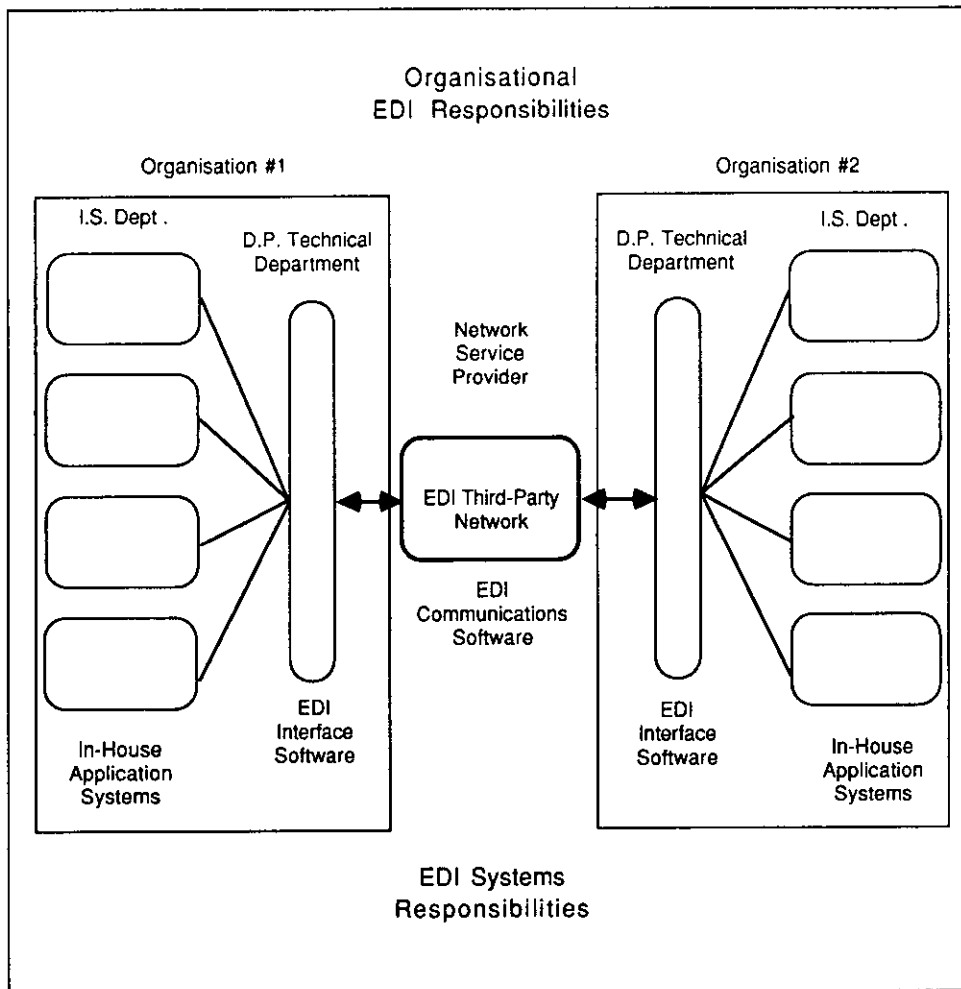

Figure 1. EDI Software Categories

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Several approaches to establishing the relative importance of the organizational and technical aspects of EDI implementation have been undertaken. One involves the development of both informal and formal models of an EDI communications system, enabling the isolation of in-house EDI interface software from the networking issues. This research project (reported in Swatman, Swatman and Duke 1991) is being further examined by means of the detailed formal specification of a complete EDI system.

Another research approach which seemed to offer real possibilities was to determine the significance of integration with internal application systems, so that this aspect might be separated from the broader question of organizational restructure. A multi-phase research program has been developed, attempting to isolate the various aspects of this question. Phase I of the research involved a survey (conducted in August 1989) of all 131 members of the EDI Council of Australia (the EDI "users group"), which established the size and rate of growth of the EDI market-place in Australia (Swatman and Everett 1991). Of the organizations approached, 62% responded to the survey and the results obtained indicate that EDI was showing significant growth, with larger organizations being more likely to be involved in EDI than small to medium ones.

The study was based in Australia for a number of reasons, among the most important of which was an attempt to understand the likely impact upon small, non-aligned trading nations of the growing number of major trading blocs (such as Europe's Single Unified Market). The movement toward electronic links within such blocs is twofold: the formation of the bloc requires the implementation of communication links for its day-to-day operation, while the greater movement of trade and information within the bloc itself tends to encourage former rivals to regard one another in a more favorable light. The self-reinforcing aspects of trading bloc formation may, however, tend to obscure the need for continued links with smaller trading partners (Swatman and Swatman 1991b). A survey instrument is currently in preparation for issue internationally in an attempt to confirm the generality of application of the results of the current study.

The survey of Australia's EDI population provided the necessary information for Phase II of the research program, reported here. The hypothesis investigated during this phase was: *there is a series of comparatively standard and recurring stages in the integration of EDI into internal applications systems.* On this basis we developed, as a secondary hypothesis, a model of the stages of integration against which actual data were compared.

1. In the first stage, we anticipated that there would be a PC with EDI software (translation and communication) requiring:

   ● a member of staff to key in outgoing EDIFACT/X12 messages and

   ● the printing of incoming EDIFACT/X12 messages.

2. The second stage would be composed of two alternate paths.

   2a. Files created by the mainframe/mini application systems down-loaded to a PC having the EDI translation and communications software (with analogous facilities for incoming EDI messages).

   This replaces the keying-in and printing-out of messages with flat files, speeding up the process and making incoming messages (in particular) more useful, since they do not require rekeying prior to use by another system.

   2b. The EDI software is itself based on a mainframe/mini computer. This is similar to the process described in 2a, save that the physical uploading/downloading is also eliminated.

   2a and 2b are essentially the same stage of integration, since the physical location of the EDI translation/communication software is of little importance. The difference between these sub-stages is therefore merely technical in nature (rather than organizational). We had originally anticipated that some organizations, seeing EDI integration as primarily a technical issue, would choose to pass through both stages 2a and 2b.

3. Seamless integration between EDI transactions and production applications such as purchasing, order entry, production scheduling, inventory management, accounts receivable/payable, shipping and so on.

Our initial, anticipated model of EDI integration is summarized in Figure 2. This diagram includes both the stages of integration and the anticipated organizational entry-points to the integration process.

In retrospect, we believe that we should also have hypothesized a further stage in which EDI was seen as an integral part of the organizational context and was a major factor in strategic and information systems planning. This final, organization-wide stage would result in EDI influencing the functional structure of the organiza-
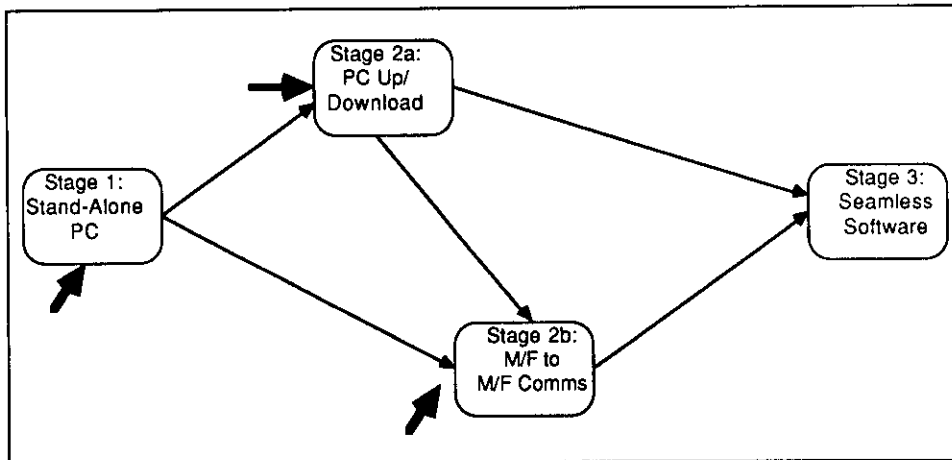
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Figure 2. Original Model of the Stages of EDI Software Integration
(Points of entry to the model are indicated by heavy arrows)
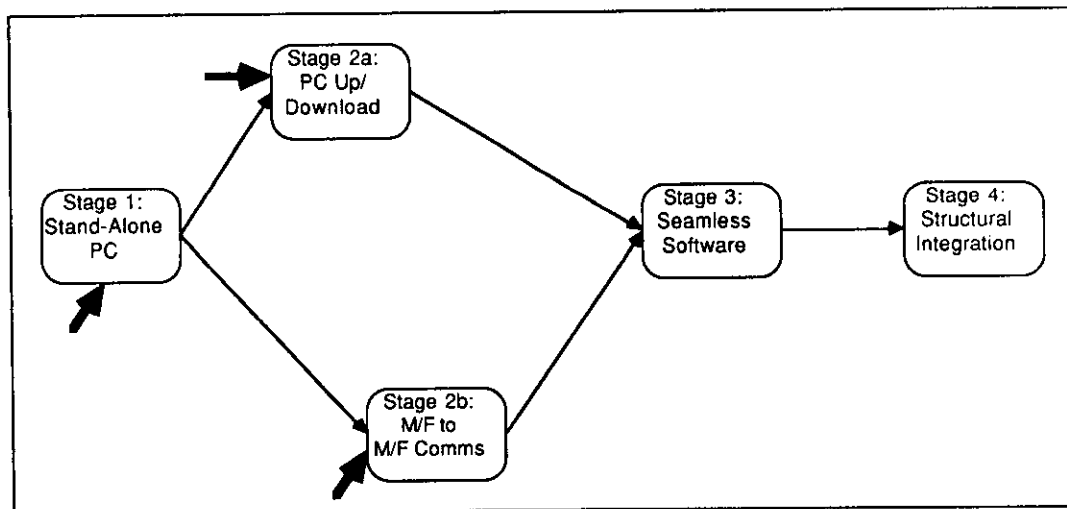

Figure 3. Final Model of the Stages of EDI Software Integration
(Points of entry to the model indicated by heavy arrows)

tion and the structure of the supportive information systems within the organization. This process of integrating information technology and overall business strategy/planning is better expressed in Benson and Parker's concept of Enterprise-wide Information Management, where the strategic business plan forms the foundation of IS planning; and the potential benefits available from IS and IT in turn influence the business plan (Benson and Parker 1985; Parker and Benson, with Trainor 1988; Parker, Trainor and Benson 1989). Figure 3 illustrates the modified, four-stage model.

We have previously argued (Swatman and Swatman 1991a, 1991c; Swatman, Swatman and Duke 1991) that it

is not, in fact, the technical issues of systems integration which retard broader organizational integration and restructure. Phase II of the study would thus provide a framework for the analysis to be undertaken in Phase III: an in-depth investigation of a small group of organizations, designed to isolate the organizational factors which inhibit overall EDI integration.

2.2 The Research Method Selected

It was decided to make use of a multiple case study approach (where participants were chosen from the members of the Phase I survey group), using personal

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interviews to gather data because of the breadth and complexity of the phenomenon: "where the existing body of knowledge is insufficient to permit the posing of causal questions and when a phenomenon cannot be studied outside the context in which it occurs," multiple case research is an appropriate choice (Bonoma 1985, p. 207). A number of earlier researchers into inter-organizational systems (see Barrett and Konsynski 1982; Cash and Konsynski 1985; Cash 1985; Keen 1986; Runge and Earl 1988; Reich and Benbasat 1988) also found this approach satisfactory.

Data were collected during 1990 by means of one or more initial interviews, followed some months later by a questionnaire and further (telephone) interviews. These follow-ups were designed to canvass opinion on the tentative conclusions which we reached following analysis of the original interview material.In each organization, we interviewed the senior management representative (non-IS) responsible for EDI and the most senior representative of the IS management structure familiar with the organization's EDI initiative. In addition, as a number of the organizations studied were participants in more than one EDI scheme, we also interviewed the non-IS senior management representative responsible for that particular EDI scheme. We shall refer to this concept in future as participant/scheme (or P/S), since we found instances within our sample of both more than one scheme within a single organization and of more than one participating organization for a single EDI scheme.

2.3 The Case Study Participants

The case studies focused on major Australian organizations which had been involved with EDI for between one and three years, since EDI in Australia was then only three years old. The organizations chosen were all medium to large in terms of both staff numbers and annual expenditure on Information Technology. Each organization was currently involved in at least one EDI scheme and could be considered relatively sophisticated in terms of its technological infrastructure (at least stage 3 of Nolan's Stages of Growth model — see Nolan and Gibson 1974). The comparative lack of maturity of the Australian EDI marketplace meant that only those organizations which had initiated an EDI scheme (or were representatives of an initiating industry group) would have made significant progress towards integration of EDI with existing internal systems and functions. Detailed information regarding case study participants' identities remains confidential at the request of several of the participating organizations.

The participants in this study were chosen to reflect, as accurately as possible, the categories of Australian orga-

nization involved with EDI as reported in two Australian surveys (Swatman and Everett 1991; Clarke et al. 1990).

Participants were drawn from the Australian parent/subsidiary of organizations in the following categories:

- an international airline (1 P/S);

- a large financial institution (1 P/S);

- an automobile manufacturer (1 P/S);

- a major supplier of parts to the automotive industry (1 P/S);

- a large primary-sector manufacturing organization (2 P/Ss);

- a major national retailer (1 P/S);

- the Australian Customs Service (1 P/S);

- two major State Port Authorities (in Australia, all port authorities are found in the public sector) (5 P/Ss in total);

- five State Government Agencies (one of these agencies also acts as a port authority for several minor regional ports) (8 P/Ss in total).

Schemes included in this model were primarily in the implementation stages, although we also included schemes which were in the final stages of implementation planning. These data therefore reflect the position as of December 1990, although in the months which followed the gathering of data, financial considerations caused the implementation of several of the schemes to be deferred.

One potential weakness of the group of participants available for the study was the relative newness of EDI to Australia. Fortunately, there was an alternative (and complementary) group of participants readily available to provide a comparison. Although true EDI has only been active in Australia for two to three years, SWIFT (the Society for Worldwide Inter-Bank Financial Telecommunications) has provided an electronic clearing-house for inter-bank funds transfer for seventeen years. Australian banks were early members of SWIFT and thus form a most interesting comparison to those organizations involved in pure EDI schemes.

Bleich (1989) defines the four basic ways in which SWIFT differs from EDI: it services a closed user group, whereas EDI places no limits upon the source of potential

Table 1. Summary of Case Study Results

Organization	P/S	M/ship Type	Progression
International Airline	1	Initiator	-> 3
Financial Institution	1	Initiator	-> 3
Automobile Manufacturer	1	Initiator	-> 3
Automotive Parts Supplier	1	Pilot	-> 1, 2a
National Retailer	1	Initiator	-> 1, 2b, 3
Primary Sector Manufacturer	1		-> 1
	2	Initiator	-> 2a, 3
Australian Customs Service	1	Initiator	-> 4
Port Authority No. 1	1		-> 1
	2	Initiator	-> 1, 3, 4
	3	Initiator	-> 2a, 3, 4
Port Authority No. 2	1		-> 1
	2	Pilot	-> 1
State Govt. Department #1	1	Initiator	-> 1, 2b, 3
	2	Initiator	-> 2b, 3
State Govt. Department # 2	1		-> 1
	2		-> 1
State Govt. Department #3	1		-> 1
	2		-> 1
State Govt. Department #4	1	Initiator	-> 1, 2a, 3
State Govt. Department #5	1	Initiator	-> 2a, 3

users; SWIFT is restricted to the financial sector scheme, whereas EDI is relevant to and used by organizations in almost all conceivable industry sectors; SWIFT is essentially a single-service provider, whereas EDI offers a wide range of services and document types; and SWIFT is essentially a proprietary product, in which both network and standards were developed by a single user group, whereas EDI is the product of international cooperation — frequently using commercially developed standards and products.

Despite these differences, the day-to-day operations of SWIFT are extremely similar to those of the average EDI system, even to the extent of the sophisticated netting facilities made possible by value-added information transfer. From the point of view of integration with internal application systems SWIFT shows still greater similarity to EDI. To the end-user organization, the process of creating documents in forms suitable for transmission via a third-party network which depends upon specified document translation and data communications standards is much the same no matter which network is being considered (Bleich 1989; Wainright-Lee 1989; Whybrow 1990; Johnson 1990). Accordingly, two Australian members of SWIFT were included in the group of participants in this study.

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3. THE RESULTS OF THE STUDY

Table 1 summarizes the results of the case studies, indicating the number of P/Ss belonging to each organization, the role played in the P/S by that organization (i.e., whether Initiator, Pilot scheme member, or merely participant), and the stages of integration between that P/S and the organization's internal systems. It should be noted that in some cases the stages of integration were still in planning at the time of the interviews.

3.1 Organizations Without Prior Experience of Inter-Organizational Systems

The majority of the organizations studied belonged to a sub-group of those who were either implementing their first inter-organizational system (or, frequently, a number of EDI systems in parallel). The remaining members of the case study group already had an inter-organizational system in place and demonstrated quite different patterns of behavior.

3.1.1 Entry-Points to the EDI Integration Model.

The experiences of these organizations supported the initial model shown in Figure 2, although we found no support for the transition from stage 2a to 2b, since organizations passed (or anticipated passing) through one of these sub-stages, but not through both.

The anticipated entry-points to the integration sequence were also validated by the experience of organizations within this group, which typically entered (or proposed entering) the integration sequence at stage 1.

Thirteen P/Ss entered (proposed entering) at stage 1, while three P/Ss entered (or proposed entering) at stage 2a and one at stage 2b. On analysis, those organizations entering at stage 2 appeared to be "piggy-backing" on the experience of other EDI implementations with which they were involved. Two State Government implementations which propose entry at stage 2 are intended to be re-implementations of schemes proposed or developed by other Government agencies, while the other stage 2 entries represent second EDI implementations. A significant number of case study participants have begun work on more than one EDI scheme over a very short period and have therefore been able to incorporate the experience gained from earlier attempts.

Looking back twelve years to the early days of SWIFT implementation in Australia (and taking into account the different computer hardware available at the time), there is further confirmation of this model of system integration. The two Australian SWIFT members participating

in our study had no experience of inter-organizational computer systems prior to their involvement in the SWIFT system. SWIFT was originally available for entry at stage 1 (represented by a printing terminal) or stage 2, by means of flat file communication between the SWIFT input/output and the banks' application systems.

3.1.2 Progress within the Model of Integration.

Membership of an EDI scheme, *per se,* provides no impetus towards integration within the organization. Eight of the twenty-one participant/schemes studied were initially implemented at stage 1 within our model and have neither progressed (nor planned to progress) towards integration. In none of these cases did the participants initiate the scheme in question.

Our findings suggested an extremely strong correlation between initiating the EDI scheme and progression through the stages of integration — indeed, only one non-initiating participant has shown progress (and that organization actually participated in the pilot scheme). It appears that what drives the integration process is the same factor which drives the initiation of an EDI scheme in the first place — an organizational perception that EDI is a natural extension of pre-existing internal operations. This does not mean that only initiators of EDI systems gain comparative advantage from integration, but that organizations joining already existing EDI schemes must take a top-down, strategic view if the benefits of comparative advantage are to be gained.

Four further P/Ss entering the model at stage 1 have progressed through to stage 2, two each to 2a and 2b (although one of the participants who has moved to stage 2a did so purely on the basis of its cheaper cost of implementation over 2b), and three of these have plans to progress to stage 3. The final P/S entering at stage 1 plans to progress directly to stage 3. All five of these organizations were either the initiating organization or participated in the original pilot stage of the scheme in question, suggesting a proactive approach to EDI.

All three of the P/Ss entering the model at stage 2 have either already moved to stage 3 or have plans to do so, while the P/S which proposes entering at stage 2 has longer-term plans to move to stage 3.

One port authority, already involved in two different EDI schemes, proposes both

- ● to integrate these EDI schemes with existing internal systems (one will move from stage 2a to stage 3, while the other will move from stage 1 to stage 3 directly as soon as the developers have extended the product sufficiently) and

o to subsume these EDI schemes into a greater, all-encompassing Port Community System.

This actually represents a move, not merely to stage 3, but rather to stage 4 (the integration of EDI within the organizational fabric). Although the port authority has been included in the category of organizations without prior IOS implementation experience, this extended proposal should, perhaps, be considered as the expression of the organization's increasing maturity.

With the sole exception of this proposal, our initial model of EDI integration has been matched within this (comparatively inexperienced) group.

Once again, the historical experience of SWIFT members confirms the generality of application of this model. Typically, members of SWIFT have moved from their starting point through stage 2 (always via stage 2b, due to the hardware limitations of the period) stage 3 and beyond, to stage 4. The internal organizations of banks have long been designed on the basis that SWIFT is an integral part of the flow of information within and beyond the organization.

3.2 Organizations With Prior Experience of Inter-Organizational Systems

Case study results suggested that the interpretation of our simple model should be extended and thus made more comprehensive by considering the following separate categories of organization and comparing their experiences:

o organizations (such as airlines, banks, etc.) which are migrating their existing EDI-like inter-organizational systems (e.g., SWIFT or SITA — Société Internationale de Transport Aèronautique) towards conformance with the internationally-agreed standards of EDI (e.g. EDIFACT);

o organizations which already have integrated inter-organizational systems in place, but which are developing a new EDI system (again, the airlines and the banks are good examples, as are many of the automotive manufacturers);

o organizations which, rather than integrating EDI with existing in-house application systems, are concerned with integrating a number of EDI systems with one another (e.g., Australian Customs Service);

o those organizations entering EDI and inter-organizational systems for the first time (already discussed above).

On examination of the three new categories, we find that the stages of integration remain unchanged. The expected entry-points to the model, however (and to some degree the order and rate of progress through the model), may vary.

3.2.1 **Migration of Existing EDI-Like IOSs.** Converting an existing and integrated inter-organizational system, which uses proprietary (and closed) standards to conformance with the open and globally applicable standards which characterize EDI, does not of itself prompt any additional integration within the organization. An IOS which is currently integrated into the organization at the level defined by stage 3 or stage 4 within our model will not be affected by the provider's move toward EDI standards such as EDIFACT. As an example, those banks which have already integrated SWIFT into their wholesale operations and which are now contemplating the full integration of their retail division are likely to enter the model at the stage previously achieved by SWIFT, irrespective of SWIFT's own move toward international document translation standards.

At a technical level, some benefits may be obtained from the move toward an EDI system by means of the open standardization of messages alone. The software systems concerned with document translation and message routing within the organization may be shared by all EDI-based IOSs (Wilmot 1988). The strategic benefit obtainable from this technological integration at an organizational level, however, arises from the integration of numerous EDI-based IOSs with one another, in addition to the pre-existing integration of each individual IOS with internal information systems. Airlines which have been using the proprietary SITA systems for cargo scheduling, for example, have the potential to gain strategic advantage over their competitors by incorporating these data into passenger reservation systems based on quite different sets of proprietary message standards.

The migration of an inter-organizational system toward the use of open standards (and, thus, toward EDI) will in itself have no direct effect on the speed with which organizations integrate their internal and external systems. The existence of two or more EDI systems may, however, provide sufficient impetus for a move toward fully mature integration as defined in stage 4 of our model. As previously closed systems (such as SWIFT or SITA) become EDI-based in their use of open standards, we can anticipate the mature integration of all the using organization's systems, whether inter-organizational or internal.

3.2.2 **EDI in Addition to Integrated IOSs.** An organization gains maturity from the experience of having

integrated any inter-organizational system. Such an organization, needing also to implement an EDI system, will take advantage of such maturity and enter the model of integration at a later stage. All three of our case study participants which fell into this category at the commencement of their experience with EDI entered the model at stage 3. The behavior of this sub-group requires further confirmation and study, since our hypotheses have been generated on the basis of the results of the present study, rather than being generated prior to undertaking the study. The indications, however, are that:

1. Such organizations will enter the model later in the sequence of stages.

2. They will progress faster through the stages of integration.

3. If they currently have other inter-organizational systems integrated at stage 3, the additional benefit gained from taking the integration of their EDI scheme to the level of stage 4 may be sufficient to encourage the further integration of the other, pre-existing IOSs.

3.2.3 Integrating Multiple EDI Systems (the Australian Customs Service).

The Australian Customs Service (ACS) forms a unique organizational group of one within our sample. The ACS (together with its New Zealand counterpart) appears to be building on the experience of the British Customs and Excise Department in perceiving EDI as the ideal data-gathering mechanism (Australian Customs Service 1989). The ACS has entered our model directly at stage 4 by means of the EXIT system and, although the initial implementation occurred in the form of a stage 2b system, this was merely the result of a phased implementation of a long-term stage 4 plan.

Prior to initiating its EDI plan (EDIFICE, of which EXIT is merely the first phase) the ACS was the hub of a pre-EDI inter-organizational system, Compile, designed to allow customs agents to pre-clear import shipments. Customs agents could not integrate the original Compile system with their own internal application systems (since this system merely utilized an on-line terminal to the ACS' computers). The ACS, however, has long been in a position to integrate: Compile, its internal application systems, and its organizational structure. This example adds further weight to our tentative conclusions regarding the experience which organizations, mature in their use of inter-organizational systems, can expect when implementing and integrating EDI.

4. CONCLUSIONS AND FURTHER WORK

The results of these case studies provide strong indicative evidence for a standard four-stage model of organizational integration of EDI. We found a significant difference between the experience of that group of respondents who were developing their first inter-organizational system and those who were building on prior experience in this area. While the hypothesized stages of integration (and the progress through these stages) was borne out by all respondents to the study, more mature organizations entered the model at higher levels and appeared to progress both faster and further. It was the experience of these organizations which led us to hypothesize the fourth, organizational stage of integration.

The factor which proved to have the greatest influence on progress through the stages of our model was an organizational perspective of EDI. Comments made by our interviewees suggest that what drives the integration process is a strategic perception of EDI as a natural extension of pre-existing internal operations. While non-initiating participants in EDI schemes have the ability to gain long-term comparative advantage from system integration, they frequently fail to take a top-down, strategic view which incorporates EDI. EDI systems are initiated by organizations which view the inter-organizational communication involved as central to their way of doing business and are therefore naturally inclined to integrate their IOSs with their existing internal systems. This finding is in agreement with Lyttle's (1988) suggestion that the full benefit of EDI implementation can only be obtained from a "proactive" approach.

In theory, there appears to be no obstacle to non-initiators gaining the full benefit of EDI system integration, provided that the organizations concerned approach such integration proactively (see, for example, McNurlin 1987; Lyttle 1988; Knill 1989; Benjamin, De Long and Scott Morton 1990). The findings of this case study, however, appear to suggest that this is not the Australian experience — rather, that it is the initiating organizations alone which are reaping the full rewards of EDI system integration. A possible explanation suggested by our results is that, in Australia, non-initiating organizations predominantly enter the integration model at stage 1, which offers no obvious advantages over such communications media as facsimile or telex. It may be that organizations avoiding even the most limited form of integration between EDI and internal information systems never gain any leverage from their EDI systems and therefore have no incentive to view EDI from a strategic perspective.

These results, while providing strong support for our initial hypotheses, have also raised a number of issues

which require further analysis and testing. We are therefore in the process of preparing a survey instrument for issue internationally which will attempt to

- demonstrate the international general applicability of our four stages of integration,

- demonstrate that our categorization of organizations by maturity in terms of inter-organizational system experience is appropriate and useful,

- further investigate the significance of entering the stages of the integration model at stage 1, and

- investigate the possibility that Australian organizations' experience of EDI integration is atypically slow.

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