

Hong Kong's EDI bandwagon Derailed or on the right track?

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Abstract

In this paper we explore the adoption of a complex networked technology - that of Electronic Data Interchange (EDI) - in the context of Hong Kong. EDI forms a complex and *interorganizational* innovation and therefore we suggest a multi-theoretical framework to examine its diffusion. The framework takes into account institutional, industry specific and organizational factors in the study of diffusion processes and thus extends the analysis beyond organizational borders. Using the framework we deliver an account of the EDI diffusion in Hong Kong based on field study data. The study clarifies how simultaneous organizational, industry and environmental factors can be brought to bear to understand the diffusion process. We distinguish six diffusion patterns and associated mechanisms that mold diffusion patterns in three diffusion arenas: local dyadic relationships, industry wide patterns, and community networks. The analysis demonstrates that EDI in Hong Kong is blooming on a grass root level and that earlier studies of EDI diffusion in Hong Kong, though in the right direction, are too simplistic and fail to account the diversity of the diffusion processes. On the theory plane our study calls for the need to orchestrate multi-theoretical approaches to study the diffusion of complex, and networked technologies.

Keywords

Electronic Data Interchange, EDI, Diffusion Theory, Institutional Theory, Hong Kong, case study

1 INTRODUCTION

Hong Kong's small geographical size and the vast amount of trade handled therein has encouraged an advancement of a telecommunication infrastructure which is unmatched by most countries. This should make one expect that the diffusion of valued-adding network services would take place swiftly.

In reality, the contrary seems to be true. Hong Kong's community wide EDI service initiative Tradelink came into existence in 1988. Since then it has received attention as the sole EDI initiative in Hong Kong (King and Konsynski 1990c, Surmon and Huff 1995). Nearly all these studies argue that EDI diffusion in Hong Kong is troublesome and the fact is that after a decade of chronic attempts the Crown Colony is still struggling to establish its community wide EDI service (King and Konsynski 1990c, Kimberley 1994, Surmon and Huff 1995).

Some argue that this have been caused by the Hong Kong Government that has been indecisive and believed solely in the marvel of market. Compare this strategy with strategies adopted by other governments in the region, especially Singapore. Singapore has tightly regulated its telecommunication services but successfully implemented several operational community-wide EDI systems of which the TradeNet is most well known (Neo et al. 1993, King and Konsynski 1990a,b).

Overall it is somewhat unclear which factors have caused Tradelink to be so unsuccessful (King and Konsynski 1990c, Surmon and Huff 1995). One would expect that one reason for the disappointing outcome is that the business community in Hong Kong is reluctant to implement EDI systems or lacks necessary skills to do so or that in an unregulated environment the adoption of all EDI technologies is likely to be a dismal. Yet, this conclusion can be too hasty as most studies have focused solely on the community wide diffusion process. By extending the analysis into specific industries and distinct locales may reveal a more vibrant and diversified diffusion process. This suggests that the diffusion of complex networked technologies can happen through several alternative paths - in this study called patterns - and it can be "pulled" or "pushed" by diverse forces that can be located at the varying levels of analysis (Damsgaard et al. 1993). In this paper we seek to answer the following question:

What are typical EDI diffusion patterns in Hong Kong, and how do these depend on organizational, industry and environmental level factors? Moreover, what has been the success rate of these diffusion patterns in terms of institutionalizing the EDI service?

We examine these in the context of Hong Kong because it offers a unique laboratory to learn about how complex technologies diffuse in an environment, which is largely unregulated, has good underlying infrastructure and follows the ethos of the "marvel of the markets". To understand more deeply the dynamics of the EDI diffusion we want to consider several adoption patterns that operate beyond and beneath institutional initiatives i.e. by probing individual organizational cases

within specific industries. Such analyses are expected to dissect interactions between multiple factors that affect the diffusion of EDI.

The paper is organized as follows. First, we characterize EDI and discuss its traits from a diffusion point of view. Second, a number of diffusion theories are introduced and we justify the need for adopting a multi-theoretical approach to study the EDI diffusion patterns. In section 4 we describe the field study and its research design. In section 5 six patterns of EDI diffusion are presented and analyzed based on a field study. In section 6 we discuss differences and similarities among distinguished patterns and predict the future of EDI diffusion in Hong Kong based on a detailed analysis of the patterns.

2. DEFINITION AND TRAITS OF EDI

The definition of EDI is as follows: *EDI technologies support standardized interorganizational communication between independent computerized systems and convey know how of integrating existing organizational information systems and organizational practices with computerized interorganizational communication* (Damsgaard and Lyytinen, 1996). EDI technologies are critical in implementing interorganizational IS that enable customer-supplier relationships and they also occur as a consequence of such relationships along Porters value system (Porter 1985). Some key features of EDI are: (a) the use of electronic transmission medium; (b) the use of structured, formatted messages based upon agreed standards; (c) relatively fast delivery from sender to receiver; and (d) direct processing by the receiving organization's application software, generally resulting in a response to the sending organization (Wrigley 1994). Among the claimed virtues of this technology are: a rapid and less error prone request/answer ratio, a quick and accurate placement and cancellation of orders, automation of repetitive administrative processes, and optimization of inventory levels.

EDI is here perceived as one step in the evolution of information technology (IT) applications within the organizational domain. It has the following distinctive traits (Damsgaard & Lyytinen 1996, Damsgaard 1997):

1. EDI is *interorganizational* in nature;
2. It links organizations by *electronic* means so that organizational "boundary" is lowered and the organization's interior is exposed to trade partners.
3. It relies on a developed *telecommunication infrastructure*;
4. It forms a *complex, innovative and abstract innovation* requiring considerable skill and know-how to implement and operate;
5. *Standards* are essential in its adoption and they must be necessarily recognized in developing the EDI system. Therefore EDI creates a high degree of organizational interdependence between participating organizations and necessitates some level of institutional regulation;

6. *Network externalities* are important in making decisions to adopt EDI. EDI requires a considerable critical mass to be efficiently deployed (Pfeiffer, 1992);
7. EDI implementations are often built on *third party operated* VANs. This is often the only economically feasible solution because creating and maintaining direct links to all partners forms a very expensive one-to-many relationship. At the same time third party services may complicate the provision of EDI services.

EDI is currently raising considerable interest, because it will not only assist organizations in doing business, but will also change the way organizations do business, i.e., to regard it as a substantial process innovation that reduces uncertainties in the supply-chain. Direct benefits of EDI include better efficiency of internal operations, better responsiveness to customers, better trading relationships and increased competitive capability. Many argue that indirect benefits are more substantial and involve profound changes in supply chain structures and relationships, which is often denoted as “business network redesign” (Short & Venkatraman 1992). In addition, usage of EDI can bring several intangible benefits such as demonstrations of competency, increases in organizational reliability, improved accountability, or better monitoring of the environment (19). No wonder, that many observe EDI adoption to be necessary to sustain the competitive capability of nations, regions and industries (King and Konsynski 1990a,b, Farhoomand and Boyer 1994, Swatman and Clarke 1990).

From a diffusion of innovation point of view EDI has several prominent features which typically characterize transfer of complex networked technologies. First, points (1), (3), (4) and (7) imply that its adoption can create complex path dependencies with earlier innovation decisions. Second, points (1) and (6) suggest that the decision to invest in EDI is not solely dependent on singular adopters but on “herd” effects of creating sufficiently large scale simultaneous adoption decisions. In other words the diffusion arena for EDI involves several organizations or industries. Third, points (1), (5) and (7) point out that the success of EDI adoption does not depend on singular adopters’ goals and desires, but as well on the effectiveness of broader institutional and regulatory regimes in creating a favorable momentum for diffusion. This may vary at different stages but is critical in the discovery and institutionalization phases. Finally, points (2) and (4) imply that due to its originality there are high knowledge and learning barriers for its diffusion (Attewell 1992). Difficulties in understanding what EDI is and can do create an additional hurdle for adoption. Because of these features we need several theoretical accounts to characterize EDI diffusion. Focusing just on the individual adopter behavior like in some diffusion accounts following Rogers’ analysis (Rogers 1983) or more recent diffusion models (e.g. the Bass model) (Mahajan et al. 90) will miss points (1) and (6). Likewise a sole institutional analysis would lead to underestimate the point (4). Therefore we wanted to use an array of diffusion accounts in our study. These will be discussed next.

3. A FRAMEWORK FOR THE ANALYSIS OF DIFFUSION

This section integrates investigations of diffusion to simultaneously cover organizational, industry and institutional factors to identify alternative patterns which EDI diffusion might follow. Parallel work by the author also report this theoretical work, where the framework is applied to examine diffusion patterns in Denmark and in Finland (Damsgaard 1997; Damsgaard and Lyttinen 1996); respectively.

3.1. Theoretical perspectives on diffusion

Each perspective focuses on specific traits of the diffusion process and clarifies distinct mechanisms that can affect its proceeding. Thereby they bring specific factors in the diffusion domain into the foreground. In the case of EDI, the following prominent traits need to be addressed while selecting the perspectives: interorganizational nature, network externalities, dependency on infrastructure, standards and complex nature. To achieve this one must distinguish between micro, meso and macro perspectives, which bring different elements and actors into the foreground. The three perspectives also complement each other by suggesting explanations, which are not available from other perspectives.

3.2. Micro perspective

The *Micro perspective* focuses on characteristics of individuals or organizational units that already use or might adopt EDI. Specific features that are crucial in this perspective are: complex nature of the technology, its abstract content, and its capability to exhibit a large number of path dependencies. The perspective relies on concepts from economics and innovation theory (Rogers 1983; Perrow 1986) and helps understand diffusion patterns among similar organizations and populations, i.e., within a narrow diffusion scope. It prominently carves out factors that will affect individual EDI adoption decisions. However it largely fails to account for diffusion factors that prevail for longer periods of time and in broader scopes, i.e., it cannot account for differences in diffusion patterns due to variances in environmental and institutional factors.

The studies informed by this perspective focus on the rate of the innovation diffusion (and differences in such rates), and how differences in communication and learning related factors influence adoption decisions (Rogers 1984). In particular, such studies emphasize intra-organizational characteristics such as user-awareness, or the type of user that might hinder or further adoption (Nolan 1973; Nolan 1979; Gurbaxani and Mendelson 1990; Galliers and Sutherland 1991). Other typical factors considered are: characteristics of the innovation, type of innovation decision, communication channels, and nature of the social system (Rogers 1993; Tornatzky and Klein 1982). Usually, according to such models,

organizations go through successive stages of diffusion finally reaching some equilibrium state. Further products or process innovations repetitively disturb this equilibrium, which may lead to successive similar diffusion curves. The S-shaped form of the curve is often used to divide the diffusion curve into distinct and recognizable stages (Nolan 1973; Nolan 1979; Gurbaxani and Mendelson 1990). EDI diffusion analysis using such models would thus focus on specific features of EDI technology such as its triability, communicability and originality (Bouchard 1993, Tornatzky and Klein 1982); and the structure of the social system in communicating such features.

3.3. Meso perspective

The *Meso perspective* (Greek, from mesos, middle) focuses, using strategy analysis and power dependency analysis, on networks of interacting agents, which shape the trajectory of innovation diffusion (Porter 1985; Kumar et al. 1995; Webster 1995; Delhayé and Lobet-Maris 1995). This perspective is necessary to cater for the interorganizational nature of EDI, its dependency on infrastructure, and on third party operators. The perspective is valuable in understanding how extra-organizational power dependencies shape and are being shaped by the diffusion process. Hence accounts of diffusion in this perspective are wider in scope as they lead to appreciate the impact of long term industry specific factors. Despite this broader perspective it fails to account for changes in regulatory regimes (such as standard setting) which embed the adopters.

Accounts of EDI diffusion in this perspective narrate stories about interactions between adopting organizations and external institutions, their mutual technology dependencies and power relationships. Transaction specific investments (such as proprietary EDI standards), information asymmetries, loss of resource control, or buying power (Kumar et al. 1995; Delhayé and Lobet-Maris 1995) may create such relationships. Each agent is regarded to actively seek to achieve some selfish ends by influencing the other agents and thereby the diffusion process (Webster 1995; Attewell 1992). Examples of agents considered powerful are: supply-chain intermediaries, trade and industry associations, multinational corporations and telecommunication service providers.

3.4. Macro perspective

The *Macro perspective* establishes boundaries for the diffusion process by recognizing regulatory regimes as focal points that constrain or enable the diffusion process. The dependency of EDI on advanced infrastructures, standards and its abstract and innovative nature legitimates the need for the macro perspective.

The regimes create a space of necessary standards, value orientations and policies that are favorable or constraining for the diffusion process (such as incentives, symbolic value given to technologies, etc.). The diffusion process

mobilizes and enacts several regulatory regimes that intersect with the technological innovation. This ranges from national and intergovernmental regimes (such as EU), to industry specific or vendor specific (such as Microsoft's de-facto regime of operating system standards for PC's). Such regimes can be identified and analyzed using notions adopted from institutional theory (Damgaard and Lyytinen 1997; King et al. 1994). The role of regulatory regimes in the diffusion process is currently not well understood. Consequently, regulatory mechanisms receives little attention in the study of diffusion processes (Damgaard and Lyytinen 1997).

3.5. An integrated framework

Combining the perspectives leads to a framework to organize the analysis of EDI diffusion into a set of interrelated issues that affect diffusion. Accordingly it helps organize data about each diffusion process and to carry out a disciplined investigation into possible causes that may hinder or speed up the examined diffusion process.

The framework investigates all EDI diffusion processes: as an uptake of technology standards and policies in some regulatory regime, as a competitive move in some industry, and as an adoption decision in some user organization. These are all a set of interdependent phenomena, and they constitute a specific viewpoint into a diffusion arena. This mode of analysis suggests a systematic, yet flexible and rich approach to make sense of a complex diffusion process that extends beyond behaviors of individual adopters and issues of communication design.

4. FIELD STUDY

4.1 Research design and method

The goal of the field study was to evaluate the applicability of the framework, to distinguish a number of distinct diffusion patterns for further elaboration, and to deliver a more systematic and detailed account of the possible reasons for the success or failure of EDI diffusion. The framework, and associated sets of issues guided the formulation of the field study. It consisted of multiple case studies (Yin 1993) which aimed at delineating typical patterns in the diffusion, and to distill theoretical constructs that can explain the evolution of these patterns. The studies focused on diffusion (or non-adoption) patterns in three industries in Hong Kong.

The study used a rich and flexible data gathering strategy which sought to find a representative and unbiased set of data. To achieve this the case studies dealt with different industries and different organizations. In gathering data we approached key informants at all layers that had a stake in the EDI diffusion in the identified arena. Accordingly, the set of informants used in the study covered:

government agencies, semi public organizations, trade associations and individual organizations. Altogether 19 organizations were interviewed. Each interviewee was asked to state their opinion on issues affecting EDI diffusion. The type of questions asked and the general set of issues covered during the interview were based on our research framework.

The overall study sample included interviewees from three industries: transportation, retail and banking. These three industries were chosen because of their importance for Hong Kong economy, their generally advanced use of IT technologies, and their largely oligopolistic structure which created fierce competition. Hong Kong is one of the four largest financial centres of the world, it has one of the three largest ports in the world, and its retail business is very advanced due to complicated logistic problems and high rents on premises. In our study, we included, representatives from the Trade Department, Hong Kong Government Trade and Industry Branch, Tradelink, and a government funded organization to improve the productivity in Hong Kong. On an industry level we interviewed specific industry organizations including: an association of retailers (retail), an association of freight forwarders (transportation), an article numbering association (retail), and three VAN suppliers (one dedicated to air cargo, one to transportation and one international VAN). On the organizational adoption layer we had representatives from: two container terminal operators (transportation), one airline (transportation), one air cargo terminal operator (transportation), two shipping lines (transportation), one retailer (retail), and two banks (banking). The interviewees were senior government officers and general managers, managing and executive directors, and at the adopting organizational level often functional or IT managers. The data gathering field study lasted 4 months, March through June 1994.

The information we sought was mostly unstructured and non-quantitative. Therefore the primary data collection method we followed was semi structured interviews. Each interview was scheduled to last approximately two hours to allow a thorough examination. The interviews were carried out using a set of open questions that were organized into a questionnaire. Moreover, we asked normal background information about the size and type of business and about the affiliation and education of the interviewee. A questionnaire developed for an European field study of EDI diffusion was used as a model to organize questions pertaining to the organizational layer to allow for comparison (Krcmar et al. 1993, Krcmar et al. 1995). Moreover, additional notes were taken during the course of the interview. The interviews were tape recorded and transcribed. Additional written documents were collected from all the participating organizations. These included information leaflets, annual reports and other printed material. Other sources of information were used as well. Articles published on EDI in *The South China Morning Post* during the period from August 92 to Spring 1994 were also analyzed.

All tape recordings and notes along with available printed material (such as information leaflets, newspaper clippings and annual reports) were subsequently

analyzed for each case (organization) and a case story was written for each interview. The case descriptions were shared with the interviewee's to check for possible errors and omissions and to evaluate the validity of our interpretation of their "story". All the errors and omissions were corrected and some stories were modified to reflect the true opinions and perceptions of the interviewees.

The resulting case stories and their description of diffusion behavior were classified into a number of themes using the study framework such as diffusion barriers in different cases, observed value of the technology, and possible benefits for the interviewee's organization. These themes were summarized into a number of typical diffusion patterns on the basis of industry and the similarity of diffusion behavior using the method of content analysis (Patton 1990). Used criteria for classifying and distinguishing typical diffusion patterns were differences in the constitution of the diffusion arena which ranged from bilateral interventions into building community wide networks, differences in the power dependencies between the involved parties, and differences in the distribution of benefits. Altogether six patterns were identified through a number of sorts and investigations of the data sets.

5. A SPECTRUM OF EDI DIFFUSION IN HONG KONG

We were able to condense six patterns. We will go through them using the scope of the diffusion arena as an ordering mechanism. We start with the more local and narrowly defined diffusion arenas, where most of the diffusion barriers relate to organizational level or industry level, to reach the broadest diffusion arena defined by a community wide EDI network initiative. These arenas are classified into three streams: local dyadic relationships, industry wide patterns, and community wide patterns. These three streams also organize the cases in terms of the complexity of the factors and issues that have to be taken into analysis in seeking to understand the success or failure of the adoption process.

5.1. First Stream: Local Dyadic Patterns

In this section we analyze local EDI adoption processes that seek to achieve relatively narrow integration effects (both horizontally and vertically). All these adoption decisions resulted in arrangements which Yates and Benjamin (1991) call "virtual vertical integration" i.e. where the control over subordinate trading partners in the supply-chain is achieved by creating electronic linkages. All studied cases had passed discovery phase and the systems were already implemented and most of them had reached institutionalized use mode.

5.1.1. Pattern One: EDI as a Strategic Initiative to Hook in Customers

The first pattern is located in a narrow diffusion locale that consists of an EDI service initiator (a bank) and its current customer base. We observed this pattern of approaching potential and current customers with new value-added service only in the banking sector. The bank had just started the service i.e. it had just passed the implementation phase and its success was not certain. The major reason for starting the service is the bank's fear of losing its customers. This is due to China's takeover of Hong Kong in 1997 which may weaken the position the bank enjoys in Hong Kong's financial market. The bank has reacted to this threat by launching a program to keep its customer base and one of such initiative has been to start a trade related EDI service. The EDI service is marketed as an add-on service to the major customers but can also be used to lock in new customers. The bank does not have considerable power over its customers, so it must "sell" the service by demonstrating that it can create additional value for customer's trade operations. The offered service has three functionalities. It mediates EDI messages between parties connected to the network; it issues electronic letters of credits; and it enables customer billing. EDI is generally more widely spread in the US and in Europe than in Hong Kong, where only the biggest importers ("Hongks") have implemented EDI. Therefore, they are also interested in using such EDI service. The bank expects that more importers will be encouraged/forced to subscribe the service by their overseas business partners. Consequently, their Hong Kong customers are hooked to the bank and its EDI service.

In this case the strategy involved risks. It was neither clear that customers would be willing to invest in the necessary technologies nor that they would have necessary skills and capabilities to utilize it. In addition, the organizational structures and incentives in these companies would not necessarily support the deployment of the service though it could benefit both the customer and the bank through reduced document handling, better business relations with their international partners, and reduced lead times.

5.1.2 Pattern Two: Utilize Power relations to Reap Benefits from EDI

This diffusion pattern evolved also in a relatively narrow diffusion arena created by one major EDI promoter. In this pattern the EDI service was rapidly adopted because its adoption was "pushed" by the powerful player in the industry sector. This pattern is very similar to EDI service relationships observed by Reekers in the US and German automotive industry, and Webster in the European automotive industry (Reekers 1993, Webster 1995). This pattern was recognized both in the banking and transportation. All the EDI services examined within this pattern were based on running and operational systems.

Case A in Banking: Obeying the Three Wise Masters from East

Three large overseas US importers demanded an international bank with locations in Hong Kong to enable EDI communication with their Hong Kong based exporter.

These three customers were important to the bank. The impression in the bank was that EDI was demanded in a way that the headquarters could not refuse. Accordingly, the bank saw no alternative but to comply and its Hong Kong branch was demanded to implement an EDI service. The Hong Kong exporter was approached with a similar proposition and it too had to implement the same EDI system. The implementation was carried out by buying a standard software package. The customization of the software was done by a VAN supplier chosen by headquarters. The role of the bank is to act as a mediator of the EDI messages between the importers and the exporter and also to issue electronically letters of credit. The number of users of the EDI system is currently four (the three overseas importers and the Hong Kong exporter). Currently there are no plans to expand the EDI system or to include more customers or new functionality.

This case was quite similar with the previous case, but the power dominance between the promoter and the adopter were reversed. Here the informants claimed that cost reductions form the most important benefit. The bank believes that EDI will help them to differentiate themselves from their competitors by offering the EDI service.

Case B in Transportation: Optimizing the Upstream Value Chain

In 1988 a large international shipping line approached a container terminal operator in Hong Kong and tried to persuade it to start to use EDI. Nevertheless an EDI system did not materialize until late 1993 and it is now in the operational use.

The scope of the diffusion pattern is narrow; it deals with the interactions between a shipping line and a container terminal. The motivation for promoting the use of EDI by the shipping line is clear. As the operations manager put it:

"We will not engage in any new operations with a terminal that is not able to do EDI. We cannot operate without EDI. If you have a lot of in-house applications and you want to get the most from them, you need real-time data and correct updates. The ability to do EDI is as important to us as the price and quality offered by the terminal."

For the shipping line it is important to know how many containers have been picked up for loading and how many have been returned for shipment. The more accurate and closer to real time this information, the better the shipping line can forecast necessary space allocation and plan the port of call. Thus benefits from an EDI linkage to the terminal operator are obvious. In the beginning of 1993 the shipping line launched a new booking system, which allows its harbor operations to be optimized with the use of an advanced forecasting system. The full value of this new system can only be realized, if information about container moves are available from the terminal operator in real time. Therefore an EDI link to the terminal operator became imperative. At this point the overseas top management of the shipping line became involved and the system was pushed to a completion.

The terminal operator recognizes that different shipping lines are eager to shift to EDI use, but it does not believe that it will benefit much from EDI. On the

contrary, the EDI system has increased its workload. The terminal now has to capture more information about each container movement, which it did not earlier have to do and which it does not use. The container terminal has altogether 30 customers, and 12 of those are doing EDI. Moreover, each shipping line requires different types of messages to be sent. Though the messages used follow the format of UN/EDIFACT messages, their contents are amazingly different. The operations manager explained:

"Different companies have different operational procedures. It is impossible to match all these needs. Everybody should be more flexible and seek to compromise more. The shipping lines receive the same format but different contents. We have different set-ups for different shipping lines. That is a hell of a job actually. The shipping lines also change their requirements from time to time and we have to cope with this also."

This means that the container terminal has to learn and sustain 12 different protocols for sending and formatting EDI messages. This demonstrates the danger observed by Delahaye and Lobet-Maris (1995) of lacking power in the EDI standard choice which results in the inefficient adoption of several standards. Before EDI the same paper form was used for communication with all the customers, but now each customer with sufficient power imposes their own standard. To make the situation worse these message formats keep changing for each shipping line suggesting their proprietary standard.¹ For the container terminal operator the current EDI system is neither a necessity nor a useful way to manage interactions with its all customers (many of which are e.g. small truck or cargo companies). Rather they perceive EDI as a way to offer a better service to their important customers (shipping lines) as to keep them from switching to another terminal thus following the slogan "EDI or DIE" (Webster 1995).

The latest development in this relationship is the introduction of new EDI based services by the shipping line from which the container operator can benefit as well. These includes EDI messages sent from the shipping line to the terminal telling how many empty containers are needed. This information will help the terminal optimize their operations and streamline their yard plan (stock of containers). The issue of faster payments has also been addressed. According to the shipping line these steps have been taken to increase the incentive for the container terminal to invest in EDI. This is clearly a step away from a situation where the shipping line tapped all the benefits towards a more win-win situation thus witnessing the similar experience from some other diffusion cases (Webster 1995). Because, the terminal has to maintain several EDI protocols they observe that the lack of standards is the main barrier for wider adoption EDI. The interviewee from the terminal also accused the government for not doing enough to create a favorable regulatory regime and sees inadequate legislation a barrier:

¹In this case each shipping line argued that they followed the EDIFACT standard. The problem was, however, that this standard is too loose to specify accurately all the details needed to define a transportation transactions.

"I think that the Hong Kong Government should do like Singapore. If the Hong Kong Government really wanted to do some good to the economy they should push EDI like they do in Singapore. There is a lot of companies in Hong Kong, if they could all use EDI everything would move a lot faster."

5.1.3 Pattern Three: Creating a Win-Win deal

This pattern differs from the earlier ones in that the initiative is organized and managed through a joint approach to develop a mutually beneficiary EDI service. In many cases this may lead to consider larger service scope and expand the resulting diffusion arena but some cases involved only dyadic relationships. Such diffusion patterns were detected in particular in the transportation sector.

CASE A in Transportation: winning the customers

Another Hong Kong container terminal has recently initialized a joint initiative EDI service. The system has passed the implementation phase and reached the institutional level of use. The terminal uses this EDI service to optimize its operations and increase its level of service to customers. The terminal was initially approached by a shipping line to start the EDI service. Top management supported the idea and shortly after the container terminal implemented the EDI system. The course of developing the system has been incremental in the sense, that the system has continuously become more sophisticated and sought to satisfy mutual needs of both the terminal and its customers. After a pilot with a major customer, other customers have been approached to start using the service. This proactive attitude to EDI meant that the terminal was able to persuade the shipping lines to implement the same standard and content which has relieved the burden of maintaining different setups for various shipping lines. The other terminal (from the previous pattern) which was waiting for the shipping lines to push EDI had to comply to the shipping lines preferences for standards and contents.

More than ten customers now receive EDI messages from the container terminal. It has restructured its operations to fully exploit EDI, and the messages are now extracted directly from available internal systems. By implementing the EDI systems the container terminal has achieved efficiency gains and improved its relationship with customers. Some strategic partnerships have also emerged which allow fast and flexible updates of the operational data. This has reduced lead times for handling containers. There are plans to expand the EDI system to accounting and to process invoices as well.

Currently there are only few big shipping lines left in a fierce competition over the Atlantic and Pacific routes. One way to differentiate itself from competitors is to provide better service and EDI is seen by many shipping lines as a means to this end. As a consequence one shipping line is currently restructuring its business from being event driven to being service driven. EDI is seen instrumental in this restructuring. The importance of EDI was emphasized by the business systems manager.

"EDI enables us to provide a better service. When prices and number of monthly departures are really the same, it is the service level that decides who gets the business. We do not try to steal customers from our competitors, but we do try to attract them with EDI."

The shipping line had initially heard EDI demands from its overseas customers and had therefore already implemented EDI service in some overseas locations. When it was approached by the container terminal it did not hesitate to go ahead with developing a system that connects its operations to the container terminal's EDI system. The shipping line believes that EDI is now a strategic necessity. The transportation sector in Hong Kong is populated by small freight forwarders and their lack of IT skills forms a considerable barrier to diffusion. The cost is also a concern because the implementation of EDI requires large investments in new technology. Here both the terminal and its customers believed that the use of EDI will differentiate them from their competitors and will add a symbolic value to the corporate image.

5.2. Second Stream: Industry Wide Patterns

In this section we analyze industry specific EDI diffusion processes which seek to reconfigure and transform a larger portion of the value adding network. Usually adoption decision on this level result in arrangements which strive towards more substantial changes in the network design either tightening and generating new forms of vertical integration or creating an arena for "vertical disintegration" through electronic markets. In all these patterns that we denote as strategic networks we observed an attempt to achieve longer term strategic advantage by transforming and changing the operations in the value system. In many cases the promoters of the initiatives included also third party VAN operators which sought to improve their business by creating monopolistic value-added services for some industry sector. All initiatives were relatively new, and at the discovery stage (save one EDI network in air cargo).

5.2.1 Pattern Four: A Strategic Network

In this pattern the dyadic relationship (vertical integration), or just one major initiator (horizontal integration) were replaced by higher level integration through strategic alliances that were created by creating a joint EDI service.

CASE A: Achieving both vertical and horizontal integration through a strategic alliance

During the time of our study a new EDI network was emerging in Hong Kong. It was formed by several large companies within the transportation industry. The network was found by chance during our study. It had not been publicly announced and was at the initial discovery phase. The aim of the network was to interconnect

the leading 5% of the companies within the transportation chain. One of the founders explained about the composition and goals of the network:

"The network is a consortium of leading transportation suppliers. Each of them offers a cargo service. It consist of companies that can provide the IT functions and IT consultants necessary to unite cargo functions into one service for the shippers in Hong Kong. So in other words there is an airline, a container terminal, a shipping line and there is the association of forwarders. Each of those has currently existing EDI links to some of its trading partners. What we are trying to do is to bring these together under one umbrella."

The network was still expanding the shareholder base with a bank and a trucking company. Its operating idea was to start with parties that share complementary interests within trading and transportation, but together span the whole transportation value system. Currently such a network would have no competitors. The size of the initiating companies is expected to create sufficient critical mass for the network in becoming the largest and the predominant network within the transportation industry. Intentions of the people behind the network are clear. By selecting companies with complementing interests, the network is a strategic move in reconfiguring the container business within the whole transportation sector (shipping lines, terminals, trucking companies, air cargo, banking).

The system will offer more than 30 basic messages including purchase orders and confirmations, booking requests, invoices, bills of lading and shipping orders in its pilot phase. Once the system is commercially launched it will connect to financial and international networks. Many of the new players indicate that it is the fear of loosing business opportunities and of being left out and the wish to prepare for EDI that has been the prime motivation for participating in the network.

CASE B transportation: Creating a Dominant Position through Market Power

A largely similar pattern could be identified within the air cargo industry. A few years ago four airlines formed a international network for coordinating transactions between freight forwarders, air cargo terminals and airlines. The founders together represented 40-50% of the air cargo volume world-wide. They wished to persuade all other airlines to join their network to form one single world-wide network. The other carriers within the cargo market saw the initiative as a strategic maneuver to hi-jack the market. They feared that the four founding airlines would dominate the market through the network. Therefore a lot of defensive actions were launched and competing airlines set up similar systems (see Christiaanse et al. 1995). However in Hong Kong the move was successful and the network became dominant. The result is that 94% of the air cargo volume flowing through Hong Kong are coordinated through the network. The managing director explained about the business strategy:

"It is simply sell as much EDI as we can. And we have a detailed plan as well. We will move further up and down the value chain. So that is to get past the freight forwarders to their customers. We also plan to go further up the value chain. That

is to go beyond Customs to the end-user at the far end. So we aim to provide an end to end service information. At the moment we occupy a niche in the middle, the aim is to spread towards both ends. So in the end we will connect the manufacturer in China and the transportation company (this may be in or out of China or through Hong Kong) to the overseas buyer."

As many small freight forwarders operate almost entirely in Cantonese the lack of a Chinese EDI solution was perceived as a real barrier. The participants were not pursuing cost reductions but rather jockeying for a better competitive position.

5.2.2 Pattern Five: Institutional intervention in the retail industry

Rents in Hong Kong are extremely high. Consequently retailers minimize their stocks, and goods are delivered several times each day (because of the small geographical size this is possible). Technologies that can assist in optimizing inventories and allow customers and suppliers to communicate in a timely and accurate manner are therefore highly applicable. The association of retailers along with the article numbering association found EDI a promising solution to this problem and took the initiative to form a EDI subcommittee. A top manager from one of the largest members was appointed chairman of the committee. The six largest member companies (from grocery) were invited to participate. EANCOM was chosen as the common standard to be used. The Subcommittee also set up targets for costs, error-rates, and benefits for a pilot project. During the pilot some modifications were made to the service. The fact that the six major players (hubs) within the retail industry started using EDI simultaneously, started EDI diffusion fast within the retail industry.

Soon after the launching the service it became apparent that even though the smaller companies knew that EDI was the right step forward within the retail industry, they simply did not possess sufficient knowledge and know how to implement and operate EDI. The article numbering association therefore decided to intervene once again. It formed a strategic partnership with a major software supplier in developing and marketing end user software packages for small and medium sized companies. At the same time the article numbering association negotiated a deal with another VAN for routing EDI messages for the whole retail industry. The deal ensures subscribers very competitive prices. In return the VAN gets the network traffic generated.

5.3 Third Stream: a Community Wide Pattern

5.3.1. The long winding road of creating an electronic trading hub

The importance of electronic trading hubs

In this stream we discuss the adoption of EDI from a view point of a community of trading organizations and government bodies forming a hub in international trade. Such a hub is an alliance of organizations which together perform logistical and

related functions in a hub. It consists of a port, an airport and a number of other transportation systems (trucks, railroad) other service providers necessary to conduct international trade (banks, insurance, freight forwarders etc.) and they all together provide critical enabling services for economic activities within the Hong Kong area (Wrigley et al. 1994). Such alliances generally revolve around government authority (or authorities) which carry out control, monitoring and enabling services for the international trading partners. Such hubs is a set of interdependent organizations and their primary responsibilities relate to carrying out international trade (and transport) through that hub. They usually need to be linked with higher level "operators" like customs, health authorities, insurance companies etc. Additionally many of these organizations operate in several hubs around the globe (shipping companies, air cargo, freight forwarders, customs agents).

The importance of providing efficient and reliable services within a trade hub is becoming of key importance in the global race between the hubs. Such hubs are evolving from providing only goods handling-facilities to offering advanced data processing services that electronically link different partners and organizations in the hub. No wonder then that Hong Kong's business and trade community has seen many attempts to establish a community wide EDI network service, because of its importance in improving its competitiveness (Wrigley et al. 1994). The first attempt was launched as early as in 1984. The latest effort to build the community wide network is currently at its implementation phase and the service is expected to be available early 1996. Hence the discovery phase of this innovation has taken over 10 years before the implementation started!

The history of establishing an electronic trading hub in Hong Kong

The first attempt to build a community wide network in Hong Kong was launched in 1984 by the Hong Kong Trade Facilitation Council (HKTF). The group proposed a project called HOTLINE (Hong Kong Trade Local and International Network). The HOTLINE network should interconnect computers in different organizations, so that necessary data for trade transactions could be directly interchanged from computer to computer among the parties involved in trade transactions.

The next attempt was called SPEDI (Shared Project for EDI) with participation from both Government and a private sector organization called Tradelink. Tradelink was set up by leading Hong Kong businesses to get government support for a community wide EDI approach in Hong Kong. The aim of SPEDI was to analyze all alternatives and options in respect to a community wide EDI network. SPEDI commenced in March 1990 and terminated in November 1990. The primary objective was to provide Government with information to make decisions on the introduction of a trade related community wide electronic data interchange service in Hong Kong. The point of departure was a desire to offer a range of services for key government transactions to trade related parties

stimulating the adoption of EDI. The principal recommendations of SPEDI was that it pointed out the need for a community wide network and also the need for a CCC (Community Coordinating Company, i.e. Tradelink). The CCC should be a mix of Government departments and private sector organizations to ensure commitment and agreement among the parties.

The need for fast action was emphasized and the establishment of a community wide network was identified as a "soft" infrastructure comparable to transportation and communication.

The following two years Tradelink and the Hong Kong government negotiated on the form and contents of a community wide EDI network. For Tradelink it was imperative to get the Governments firm commitment to EDI and to get a long lasting franchise to ensure stable working conditions. The Government on the other hand was not used to this kind of negotiations and had no earlier experience to rely on. They therefore preferred no or at least a short franchise (for a general description of Hong Kong's IT policies see Greenfield and Lee 1992). The Hong Kong government finally gave in and commissioned a seven year franchise to Tradelink.

One reason for this, though not always publicly announced, is the Hong Kong governments fear of losing competition with Singapore after its success in launching the TradeNet system (Neo et al 1993). To stay competitive and ahead of the other hubs was a major motivating factor for Hong Kong Government to finally commit itself. As one government official noted:

"The main emphasis here in Hong Kong is to stay alive and to maintain a position in the world league. So in that sense any investment to keep us there can be interpreted as strategic. If we don't do EDI we might end up not doing the right sort of business that is beneficial..."

By 30 September 1993 an IBM lead consortium was awarded the right to supply and build the first phase of CETS. The total value to the consortium was estimated to be as much as HKD 200 million over a 8 year period. IBM and Tradelink signed a *Memorandum of understanding*. However the corporation with the IBM became shortlived. In late May 1994 it became apparent that an agreement with IBM on key issues was unlikely. In October 1994 Tradelink and IBM announced that they would not be continuing the negotiations and the Memorandum of understanding was canceled.² The reason for this break is still unclear, but problems in settling the conditions and terms of CETS and in particular which party should be accountable for different aspects of the projects were named as the main causes for the split.³ When the relationship with IBM began to fail Tradelink invited a number of other vendors to put forward contingency proposals. Tradelink decided that there was no time for a second round of *request for*

²Tradelink Electronic Document Services: background information, Newsletter, Tradelink Electronic Document Services Ltd. 1994

³Community EDI pact is finally sealed by HP, Computer World (Hong Kong), December 15, 1994, Vol. XII, No. 11, pp. 1 and 4

proposals, but instead Hewlett-Packard was chosen to be the new technical partner. The participation of HP will cover two main areas which is the design and building of shared EDI facilities and the development and marketing of end-user software for the service. Testing is expected to start ultimo 1995 and the commercial service will start in 1996.

Within this arena several reasons explain the painful diffusion of the electronic trading hub. Government informants saw that the chronic shortage of IT professionals forms a major barrier to diffusion. Hong Kong has also in recent years experienced a growing "brain drain" due to the uncertain future of the colony. The high portion of SME's also forms a barrier because their maturity in using IT is low. The small number of companies having adopted EDI slows down the diffusion because of network externalities. Moreover, government authorities did not want to release their decision power to process trade declarations, export licenses or certificates of origin but instead these will be forwarded to different state departments for "checking and validating". This approach is not likely to reduce the handling times like in TradeNet which provides this services fast and automatically and uses sampling and focused examination in finding mistakes, errors and violations.

Industry champions saw that the lack of an early and strong commitment from the Government as an essential reason for the slow progress. In fact many regarded Tradelink to be a significant barrier:

"Hong Kong is getting there too late. Most countries in Asia now have their own EDI program. I have never heard Tradelink describe any incentives as to why someone should do EDI, they always focus on the technology. The whole business community is waiting for Tradelink to happen. The companies we have been in contact within the import and export industry tell us, that are not going to do anything until Tradelink is up and running."

Overall there is too much uncertainty and speculation of the possible service to be able to rely on this in planning for the future strategies. The recent attitude change of the Government has restored some faith in community wide EDI: *"The Governments positive non-interventionism policy is what in most cases has made Hong Kong so successful in many areas. Businesses has been able to work without having to worry about what the Government is going to dump on its back next. So Government and government servants have gotten used to the idea of not getting in the way of business and not doing anything to help. But what is gradually coming above is Government's recognition that an EDI community wide system is as much an infrastructure as the road system. That recognition has been slow to come, but it is there now. EDI still takes much more effort, but the Government is now paying attention to the electronic infrastructure."*

6. DISCUSSION AND CONCLUSIONS

Our study has revealed six different patterns of EDI diffusion. None of these patterns are uniquely new as all of them have been in one form or another discussed in the literature. We also know a great deal of the factors that affect the success of each of these diffusion patterns. What is unique in our analysis, is to show how these patterns are interwoven and take place simultaneously within a specific socio-economic unit like Hong Kong. Therefore the picture of EDI diffusion is much more coloured and diverse as one would guess from earlier studies.

Despite the grim experience associated with the community wide EDI service Hong Kong has made a steady progress with the adoption of EDI technologies. This has taken place mostly at the grass-root level, or through fierce rivalries at some key industry segments. In fact, some interviewees argued that the general level of EDI use in some areas had passed that of Singapore where the EDI use has mostly been concentrated on government related interactions (and not on advancing business-to-business related transactions).

Our analysis suggests that a more complete understanding of EDI diffusion rates and patterns requires both breadth and depth in the analysis – not only at the organizational level, or within the industry sector or using institutionally based analysis. We need all of them simultaneously in the study of EDI diffusion and accordingly we should focus on a complex mixture of different elements located at different levels of the analysis. Moreover, the often ignored institutional level is important and especially the role of the government is significant in understanding some features of the diffusion process.

This is visibly demonstrated by the policies of the Hong Kong government which has until recently played a role of positive non-interventionism due to uncertainty, ambiguity and lack of vision for doing EDI. Nearly all agree that this has greatly slowed the diffusion of EDI within all arenas. The government has now given up this role and it has considerably changed the conditions for diffusion, yet it is unclear what the outcomes of this change are especially if a competitive alternative emerges.

In the past most of the initiatives have been launched within local arenas in industry segments and many of these have been implemented with considerable success. Like in Boucharde's study (1993) we observed that the main reason for adopting EDI in all dyadic cases has been the "herd" effect and not the direct benefits or other intangibles accrued through EDI use. The key question in singular adoptions was: whether important business partners are using EDI or whether these partners mandate its use. Both of these reasons were observed among all the local adoption decisions. Mandated uses involved often power struggle, as in the case of the bank being pushed to do EDI and in the case of the shipping line pushing the container terminal.

At the level of industry wide patterns the logic of adoption decisions was more complicated. Organizations did not decide only on adopting the EDI service,

they were also opting for a specific strategic choice and seeking for a business opportunity through a business alliance. Such alliances could operate either in the co-operative or in the conflict seeking mode. In the case of retail industry the association of retailers had taken the challenge, and played a significant role in clearing a co-operative arena for the EDI diffusion. In other industries, such initiatives have been left to different strategic coalitions to pursue and many competitive configurations prevail. Such strategic networks most often happened in industry segments where no strong central institution exists to defend the common good of the industry.

At the level of community wide network the major diffusion barrier seems to be a lack of a strategic vision at the governmental level of the role of the EDI service in positioning Hong Kong as an international trading hub. This lack of vision has also created the atmosphere of positive non-interventionism which was much criticized by the industry representatives (terminals, airlines, shipping lines, banks).

In a nutshell the major diffusion barriers in Hong Kong are neither technological, nor economic. They cover a mixture of institutional, socio-economic and cultural factors including: 1) lack of information and EDI related skills (i.e. knowledge barriers). 2) lack of IT professionals and low maturity in using IT in many sectors which can be explained by the size and management traditions of the Chinese firms. 3) lack of Chinese (Cantonese) solutions in some industry sectors. 4) lack of persistent institutional arrangements which would create trust of the future of the provided EDI services. 5) government's low profile and lack of active involvement in developing a coherent EDI strategy for Hong Kong.

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