GLOBAL TRANSFER OF EDI TECHNOLOGY: A MULTI-LEVEL APPROACH

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ABSTRACT

Electronic Data Interchange (EDI) is a technology which has shown significant impact not only at the individual organisation level, but at industry-sector and even at the country-level. As the issues to be addressed at these levels are different, a *systemic* study of EDI technology transfer incorporating multiple levels is necessary for developing a holistic understanding of the transfer process. This chapter provides such a framework of global EDI technology transfer which can be used for analysing and planning EDI implementation within a country, an industry-sector, or an organisation. The chapter explores EDI implementation across two dimensions: *breadth* and *depth*. The breadth dimension focuses on the *scope* of EDI technology transfer -- a country, an industry-sector, or an organisation. The depth dimension focuses on the maturity of EDI usage, which is differentiated into three levels roughly corresponding to "learner", "practitioner" and "expert" levels. The chapter then identifies *critical success factors* across these two dimensions. These factors are grouped into "critical success areas" which are used to define a conceptual framework of EDI technology transfer, and to apply this framework to some countries and industry-sectors as example. Finally, the chapter uses the framework for proposing an approach for planning the EDI technology transfer process.

INTRODUCTION

Technology could be defined as knowlegement can be studied, codified, and taught to others (Weick, 1990). *Technology transfer* basically refers to the application of such knowledge and can cover the entire spectrum of events from conceptualisation of a new technology to its industry-wide use. An important component of the transfer process, *technology implementation* refers to the process of large scale institutionalisation of the new technology in organisations. Often the technologies of interest deal with physical products or processes whose scope is limited to only a few organisations or at the most an entire industry-sector. However, some technologies have much wider impact as they deal with inter-organisational information flows affecting business performance and relationships of organisations across multiple industry-sectors in several countries. The transfer of such technologies, therefore, needs to be studied *globally* in order to improve our understanding of the issues related to their successful implementation. *Electronic data interchange* (EDI) is such a technology, which can be defined as the *inter-organisational, computer-to-computer exchange of business documents in a standard, machine-processable format* (Emmelhainz, 1993). Some key features of EDI are: (a) the use of an 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 computer application software, generally resulting in a response to the sending organisation (Wrigley et al, 1994).

EDI technology gives organisations an opportunity to exchange electronic messages instead of paper business documents, and leads to a new way of doing business *electronic commerce*. Because of the need for a structured form and agreed standards, the introduction of EDI requires considerably more planning and co-ordination than while introducing other forms of electronic communication. Direct benefits of EDI include labour-savings in the areas of data transcription, controls, and error investigation and

correction, and fewer delays in data-handling. As a consequence, EDI (Emmelhainz, 1993): (a) improves internal operations of a firm from a reduction in process-cycle time, (b) improves responsiveness to customers, (c) helps improve trading partner relationships, and (d) increases ability to compete, both domestically and internationally. These *indirect* benefits of EDI may prove to be even more significant strategically than the direct ones, but can only be obtained from closer integration among related functions within different organisations.

Many industrialised and newly industrialised countries, such as the U.S.A., Canada, Japan, Australia, and Singapore have been successful in exploiting the strategic potential of EDI, especially in international trading (Farhoomand, 1992; Clarke, 1994; Masson, 1992; McCubbrey et al, 1994; Neo, 1994). EDI is also very attractive to many developing countries, who intend to strategically compete in the international market by reducing the length of *procurement/ delivery cycle* through EDI. As a consequence, many developing countries are actively considering EDI technology even though the technology infrastructure required for EDI in these countries is not very adequate (Doukidis 1993). However, there are also many countries such as Hong Kong (Damsgaard et al, 1994), who have not been very successful in adopting EDI technology to their own environments. The major barriers to the successful transfer of EDI technology as often found are:

(a) limited EDI awareness,

(b) lack of government support,

(c) weak technological infrastructure such as value-added networks and other services,

(d) high percentage of small and medium-size enterprises, having small volume of transactions insufficient to justify EDI investment,

(e) bureaucratic "paper-oriented" business culture and public administration,

(f) primitive "batch-oriented" business information technology environments, and

(g) cheap human labour in case of developing countries.

Thus an interesting question relates to factors which contribute towards successful transfer of EDI technology into a country. Furthermore, as EDI adoption varies between different industry-sectors (even within a country), another question posed is that for a given industry-sector, what factors contribute towards the successful implementation of EDI technology within the organisations in that sector. There have been many studies of EDI implementation (as for example Banerjee et al, 1994; Bouchard, 1993; Cox et al, 1995; Holland et al, 1992; Krcmar et al, 1994; Mackay, 1993; Pfeiffer, 1992; Reekers, 1994; Reekers et al, 1993; Reekers et al, 1994; Saunders et al, 1992; Scala et al, 1993; Thissen et al, 1992). Unfortunately most of them have focused mainly at the **organisational-level characteristics** and not on either country-level or industry level characteristics.

Whereas successful transfer of any technology depends on some key factors, EDI technology is different from many other technologies in the sense that these factors are not merely technological or organisational in nature. They are also *environmental*, needing intervention of governments and international organisations. For instance, successful EDI technology transfer needs large scale availability of low-cost value added telecommunication services. But it also needs willingness of trading partners to enter into formalised business relationships, and even more important, legal acceptance of electronic documents and regulatory structure for global electronic commerce.

Because issues in EDI technology transfer are complex and dynamic, a structure is needed to analyse the issues. A *framework* provides that structure as it identifies and organises context variables for research and practice (DeSanctis, 1993). Frameworks do not lend good insight into cause/effect relationships, rather the power of frameworks is that they provide a short-hand language for describing the relation. They highlight important dimensions as well as suggest which dimensions may be unimportant (Neumann, 1994). Frameworks are *not* theories; they are only a classification language. Therefore a framework could be applied for analysing the issues in the EDI technology transfer.

Furthermore, in order to make the analysis more meaningful, the issues should also be related to the stakeholders in the transfer process.

This chapter provides a conceptual framework of global EDI technology transfer which can be applied *universally*, i.e. in industrialised, *newly* industrialised as well as developing countries. It explores EDI implementation across two dimensions of its *breadth* and *depth*. The breadth dimension includes three levels in descending order of *scope*: country, industry-sector, and individual organisation (Fig.1). This *multi-level* approach is deemed necessary because each level has its unique characteristics, nature of EDI impact, success factors, and resource requirements.

The depth dimension of EDI technology transfer captures three *maturity-levels* of organisational use of EDI. These levels refer to *discovery*, *operational use*, and *strategic use* of EDI. They roughly correspond to using EDI as a "learner", "practitioner", and "expert". Again, the need for multiple levels arises from our finding that each one differs in its impact, success factors, and resource requirements.

EDI implementation at the organisation-level has been studied extensively. Therefore, this chapter will discuss *critical success factors* of EDI implementation at the country and industry-sector levels, spanning across the entire depth dimension within each level. The chapter is organised as follows. The next two sections describe the levels of EDI technology transfer *scope* and the EDI *usage maturity* respectively. The subsequent three sections define the CSFs of EDI technology transfer and describe those CSFs at the country- and industry-sector levels. The two subsequent sections describe a framework for global EDI technology transfer and identifiy stakeholders in the country-level EDI technology transfer. The section following it applies the framework to some selected countries. Finally, an approach for planning EDI technology transfer is given, followed by the conclusion and recommendation for further research.

EDI TECHNOLOGY TRANSFER *SCOPE* (BREADTH) LEVELS

This dimension defines various "units of analysis" for understanding the EDI technology transfer process, which are: (a) the *country*, (b) the *industry-sector/community*, and (c) the individual *organisation*. These three units are chosen for analysis because: (a) they provide a continuum of a broad to a narrow analytical focus (Fig.1), (b) each unit can be identified as a distinct behavioural entity having its unique set of characteristics, and most important (c) the three units together facilitate a systemic study of global EDI technology transfer.

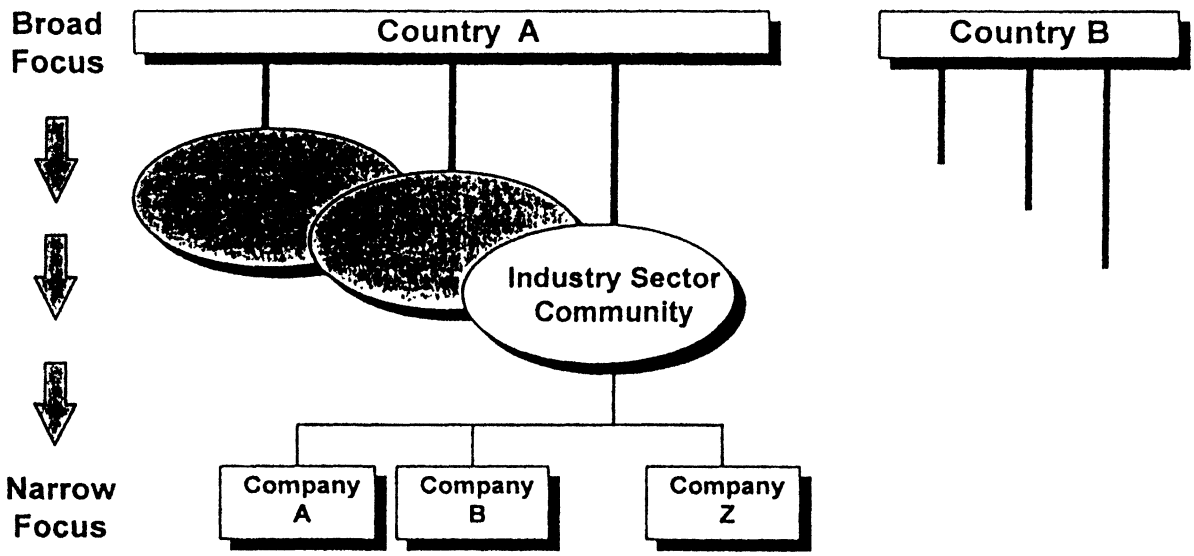

Fig.1. *Levels of Scope* of EDI Technology Transfer

EDI Technology Transfer at Country-level

Countries have characteristics such as geographical location, economic structure, government policies, national values and culture, technological infrastructure, etc., and may compete globally for economic growth and development (Porter, 1990). Many of these factors may affect EDI technology transfer and in turn be affected by it (Clarke et al, 1992). Many countries perceive EDI as a critical technology for facilitating their economic growth and improved quality-of-life, but either lack resources for its country-

wide implementation or are unable to promote its adoption in crucial sectors. Thus, a country-level analysis of EDI implementation success factors is very important.

EDI Technology Transfer at Industry-sector/ Community Level

An *industry-sector* represents a collection of distinct but inter-related industries which share resources or concerns or both. Examples are the transportation, retail, health-care and financial industry sectors. A *community* is a collection of distinct industries from one or many sectors and public administration bodies, which are inter-related through a *business network*, i.e. the structure of inter-dependent relationships between the activities of those organisations which influence each other's strategies (Kambil et al, 1994). Communities are seldom identifiable, concrete entities, but can be conceptualised as *virtual* sectors in order to improve understanding of *co-ordination* between inter- and intra-sectorial as well as public administration organisations resulting in economic activities of mutual interest. For example, a "port community" can be conceptualised as a virtual sector composed of a number of organisations such as the port authority, customs, shippers, forwarders, importers, exporters, plus a number of other roles (Wrigley et al, 1994).

An industry-sector or a community has many characteristics, such as concentration level (i.e. the extent to which market share is *concentrated* among few dominant firms), coordination needs, industry-level critical success factors (Rockart, 1979), importance in the government policy context, etc. These affect EDI technology transfer and an understanding of their inter-relationship is highly desirable. Furthermore, often the EDI implementation studies assume competition playing a major role in EDI adoption, but in some industries, such as health-care and telecommunications, competition is often heavily constrained. Thus, such studies need to consider an overall view of industry-sectors, not so much in the context of a centrally planned economy but rather as a linked set of organisations whose freedom of action is constrained (Clarke, 1992). Therefore, the conventional and limited view of EDI implementation from an individual organisation's

perspective needs to be complemented by a broader and deeper appreciation of the relevant industry-sector/community view (Clarke, 1992; Lobet-Maris, 1994).

EDI Technology Transfer at Organisation-level

Organisation is the most common unit of analysis for studying EDI implementation as it provides a highly tangible boundary for understanding business entities. Moreover, EDI is now seen as essential to successful business operation, and in many countries soon there may not be much choice over whether or not to use EDI. Even this level of analysis provides ample challenge in understanding the EDI implementation process due to complex interaction of various organisational characteristics such as strategy, structure, culture, technology, etc. Therefore, an organisation should be the smallest unit of analysis for understanding EDI implementation success factors.

"EDI MATURITY LEVELS" IN EDI TECHNOLOGY TRANSFER

The *EDI usage maturity* refers to the extent to which EDI-based solutions have been adopted and integrated to achieve business objectives. It is an important dimension for understanding EDI technology transfer as the higher the usage maturity, the more wide or outward-looking, dynamic and complex are the issues involved (Fig.2).

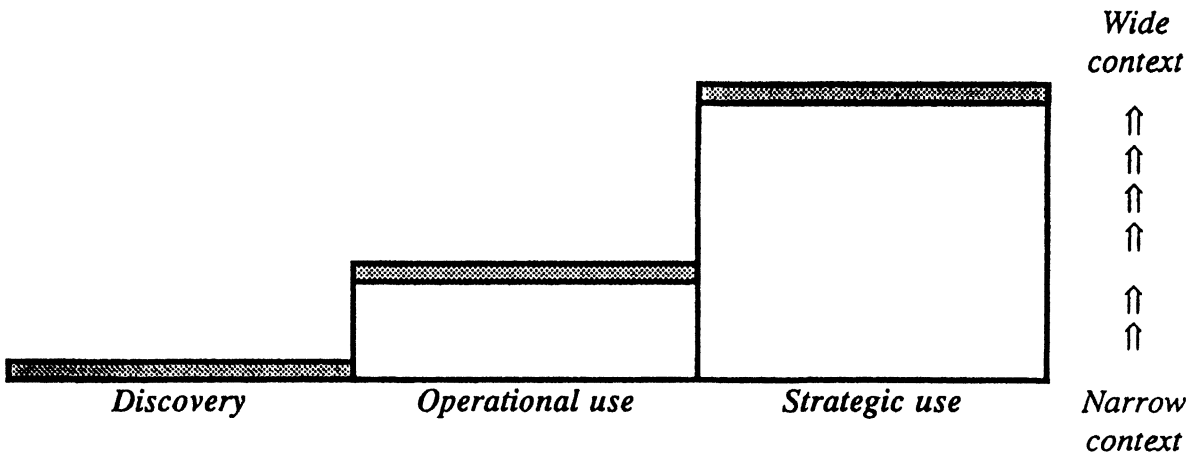

Fig.2. The *EDI Maturity Level* Staircase

The EDI usage maturity could be described using the concept of an *EDI life cycle* which has three main stages of the EDI implementation process (Holland et al, 1992):

Discovery Stage

This stage signifies awareness of EDI technology, developing an understanding of the concept of *electronic commerce*, generating interest in the need for, and opportunities to achieve sustainable business benefits through EDI. A country (or city-state) should be considered in the discovery stage if the majority of its major industry-sectors/communities is in the discovery stage and none of them in either the operational or the strategic use stages. Similar criteria could be stated for categorising an industry-sector/community in the discovery stage, using organisations belonging to the sector/community as a basis.

Operational Use Stage

This stage signifies a working EDI system by gaining the inter-organisational ability of electronic document exchange. A country (or city-state) is in the operational stage if the majority of its major industry-sectors/communities is in the operational use stage and none of them in the strategic use stage. Similar criteria could be specified for operational use stage of an industry-sector/community.

Strategic Use Stage

This stage builds on the expertise gained in the earlier stages to exploit EDI for improving the *competitive position* of the business, an industry-sector, or a country (Leyland, 1993). As a by-product, such use may also lead to new products/markets, new business relationships, new organisational forms, and/or new sector/community structures. A country is in the strategic use stage if either (a) it has an explicit formulation of its "strategic vision" and the majority of its major industry-sectors is at least in operational use stage; or (b) if at least half of its major industry-sectors is in the "strategic use" stage. An industry-sector is in the strategic use stage if the sector as a

whole has, and is working for realisation of, a "strategic vision" and a majority of organisations in the sector are in operational use stage.

These stages appear to represent an *evolutionary* path from discovery to operational use and finally to strategic use; but in many cases it could also be *iterative* as well. Organisations make mistakes and have to rectify some of their initial errors, for example lack of education and training, or lack of understanding of changes in the industry-structure or the global business environment, etc. This may constrain their move back from strategic use to operational use, and so on.

CRITICAL SUCCESS FACTORS OF EDI TECHNOLOGY TRANSFER

Critical success factors (CSFs) are those characteristics, conditions, or variables that when properly sustained, maintained, or managed can have a significant impact on the competitive success of an organisation, an industry-sector, or a country (Rockart, 1979). In the context of EDI technology transfer, CSFs refer to the *critical enablers* in the successful development, use and diffusion of EDI applications (Kremar et al, 1994). This section will describe the CSFs for successful EDI technology transfer using the dimensions of technology transfer scope and EDI usage maturity. The *scope* dimension would cover CSFs at the country- and industry-sector levels, and within each of these, it will include CSFs for the three usage-maturity levels.

Identification of CSFs is a long-term "watch-dog" exercise which, given the relatively short history of EDI and the complexity of *combining* long-term observations of countries, industries and organisations together would be very difficult to do purely by empirical methods. Therefore the CSFs were identified using a combination of analytical and empirical methods:

(a) *Systemic analysis* (Checkland et al, 1990) of EDI technology transfer based on the hierarchy of country, industry-sector and organisation and their emergent properties.

(b) *Content analysis* (Weber, 1990) of published empirical research on EDI implementation and secondary sources such as industry analyses, EDI directories and reports.

(c) Comparative analysis of similarities and differences among various socio-economic characteristics, and EDI implementation success or failures in some selected countries and industry-sectors.

Effective management of CSFs requires that these should be only a few in number (Rockart, 1979). Therefore, if the number of CSFs turns out to be large, they should be aggregated, if possible, into broader groups for parsimony, conceptual clarity and manageability. This happens to be the case here because the number of CSFs for all the maturity-levels is rather large at the country as well as industry-sector levels (as we shall see in Tables 1 and 2). We would therefore categorise them into a few broader but homogeneous groups in order to make them conceptually more meaningful. Our research on CSFs made it clear that the CSFs can be broadly grouped into six categories, which are the *same* at the country (Table 1) as well as at the industry-sector (Table 2) levels. These categories, called the *critical success areas*, are: (a) strategy development, (b) EDI technology infrastructure, (c) IT maturity of businesses, (d) EDI co-ordination, (e) EDI education and expertise, and (f) business culture. The latter refers to characteristics of the business practices, the business environment and the business people (Randlesome et al, 1993).

CSFs AT THE COUNTRY-LEVEL

Discovery Stage

During this stage the issues of critical importance are the country's economic strategy, its technological infrastructure, awareness about EDI and its perceived need, and people's skills in IT.

Perceived Need: EDI implementation efforts depend on its *need* as perceived by the government and/or industry firms in a country. For example, countries having export-oriented economies with distant markets for their products may perceive need for EDI more than those having less export emphasis or having nearby markets. Similarly EDI need may be perceived by countries who intend to improve the cost-effectiveness of public services such as health-care, etc.

Strategic Vision Development (*Envisioning*): Strategic vision of a country describes the *image* of the country's possible and desirable future state, and is required by any country planning for radical economic change. Vision provides a broad-directive target to help countries plan when they cannot easily predict. Some countries view EDI as a core technology to realise their strategic vision, and are more successful in EDI adoption compared to some other countries who do not. For example, trade has been Singapore's main source of survival and prosperity, therefore Singapore's strategy has been to enhance its global competitiveness as a trading nation (Neo, 1994). This strategy was translated into a vision of being one of the pioneering nations to have *electronic trading* by implementing an EDI-based community trading system. On the contrary, export-dependent Hong Kong lacked such vision and perceived EDI merely as a replacement for trade paperwork; which delayed the adoption of EDI even until now (Damsgaard et al, 1994).

Technological Infrastructure Planning: A major requirement for EDI to be tenable is the availability of sufficiently sophisticated and reliable data communication networks and value-added network services, extending at least to the major industrial and commercial centres (Juric, 1994). As the infrastructure may not be developed overnight, planning for overcoming infrastructure weaknesses is essential for moving from discovery to operational use stage. For example, telecommunications should be liberalised in order to facilitate availability of low-cost value-added network (VAN) services.

Table 1. Critical Factors for Successful EDI Implementation at the Country-level

Critical Success Areas	Stage		
	Discovery	Operational use	Strategic use
Strategy development	Perceived need Strategic vision development	Vision implementation	Vision review/ modification
EDI technology infrastructure	Technological infrastructure planning	Infrastructure development	Infrastructure upgrading
IT maturity of businesses	IT diffusion in business		
EDI coordination	EDI coordination mechanism	Government use of EDI EDI standardisation Regulatory/ legal structure	International liaison Strategic EDI planning
EDI education & expertise	EDI education and promotion	EDI knowledge diffusion	EDI expertise management
Business culture	Formalised business relationship development	Willingness to compete internationally	Structural change in industries

IT Diffusion in Business: Developing countries are often dominated by small and medium-size enterprises, which are often slow in adopting IT. Senior management of these organisations tend to lack awareness of IT and feel that either they do not need it or could not afford it (Gable et al, 1992). EDI is a sophisticated technology and poor diffusion of IT in business environment will mean general lack of appropriate technology required for EDI implementation. Specific IT education and development programmes, such as the Small Enterprise Computerisation Program (SECP) initiated by Singapore in 1986, may be necessary to overcome IT diffusion problems.

EDI Coordination Mechanism: *Co-ordination* refers to managing dependencies between activities (Malone et al, 1994). Coordination of various activities such as government regulations, EDI standardisation, liaison with potential users and EDI service providers within and between various industry-sectors, etc. is extremely important at the

country-level EDI implementation. Most countries have some type of coordination body, such as EDIforum in the Netherlands, which facilitates these activities.

EDI Education and Promotion: The business community's adoption of telecommunication-based applications in general, and EDI in particular, is often delayed generally due to lack of understanding of potential strategic benefits which can accrue from their effective utilisation. There is, therefore, a strong need for business people to gain a wider education on EDI. For example, in the Netherlands, the VEDI programme was initiated to provide EDI experience to organisations in various sectors (van der Net et al, 1992). In many countries such as Greece and UK, *EDI awareness centres* have been opened who play a major role in EDI promotion and training.

Formalised Business Relationship Development: EDI enforces a *formal* co-operative business relationship which may be contrary to the business culture of a country. Thus, an important issue is the need for 'maintenance' or 'enforcement' of the co-operative business relationship over a longer period of time in order to forge this relationship into an alliance as well as to overcome the threat of opportunism, i.e. behaviour involving self-interest seeking with guile (Williamson, 1975). One extreme for reducing opportunism is that of explicit contracts and legal enforcement which forms the foundation of Anglo-Saxon business practices (Willcocks et al, 1995). These have tended to over-emphasise litigation, law and regulation at the cost of institutionalising trust throughout society. On the other extreme are societies where trust and reputation take on greater importance, such as in the Asian business environment. A third type of situation faces organisations doing business in areas such as Eastern Europe and developing regions such as Africa, where there is neither strong legal enforcement nor high levels of trust in society. Since EDI enforces formalisation in co-operation, it favours the first extreme. Therefore, in countries where formal contract is not the common business practice, this cultural barrier may also need to be overcome to promote international co-operation through EDI.

Operational Use Stage

The CSFs for this stage are the factors which would ensure EDI start-up and its continual growth along with the associated benefits.

Vision Implementation: The realisation of vision requires planning and committing resources for projects and programmes for leading the country towards the envisioned state. A prerequisite for this would be a national IT plan describing these projects and programmes (Doukidis, 1993). Singapore had its National Information Technology Plan in 1986 which identified EDI implementation as part of the plan (Raman, 1993).

Technological Infrastructure Development: Infrastructure development which was planned during the discovery stage, such as availability of low-cost VAN services, must be in place during the operational use stage. A national IT plan would greatly facilitate this development, as in the case of Singapore (Raman, 1993) and Greece (Doukidis, 1993).

Government Use of EDI: Government may set an example for the non-adopters by using EDI in areas such as tendering, taxation returns, etc., and can provide a stimulus for the development of infrastructure and culture necessary for EDI's widespread use (Clarke et al, 1992). As an example, EDI use in trading would not be very successful if the government agencies (such as customs) themselves do not start using it [Gotschlich, 1992].

EDI Standardisation: Standards make a vital contribution to the EDI infrastructure. The acceptance of a common message standard is a fundamental requirement of EDI. Ideally, standards should be common across various industry-sectors in a country. This would provide a wider market for EDI messages, and thus has the

potential for reduced EDI costs. In addition, a commonly accepted standard would also reduce the occurrence of a "hub" enterprise forcing its small trading partners to use a *proprietary* EDI standard. It is for this reason that an internationally accepted UN/EDIFACT standard has been developed, but other standards such as ANSI X12 also exist.

Regulatory/ Legal Structure: The regulatory structure imposed by government may be a constraint to EDI implementation and require change, in some cases through changes to the law (Clarke et al, 1992). For example, contract definition may need to be changed legally to accept electronic in lieu of paper documents. Similarly liberalisation in telecommunication may be necessary for encouraging third-party VAN services for EDI.

EDI Knowledge Diffusion: Early adopters of EDI develop valuable knowledge out of their EDI experiences. In order to avoid recurrence of costly mistakes by late adopters, there should be mechanisms for diffusion of this knowledge, such as EDI user associations, industry-specific associations, and EDI publications.

Willingness to Compete Internationally: EDI facilitates comparative advantage which is gained through co-operation with other countries. Thus, willingness to compete globally through international trade, investment, travel, and commercial innovations is a factor critical to successful EDI implementation (Clarke et al, 1992). Without it, there could be hardly EDI-based international trading, which may hamper EDI diffusion in other sectors.

Strategic Use Stage

The CSFs for this stage mostly relate to the national and international environment for finding and exploiting innovative/ strategic opportunities involving EDI use.

Vision Review/ Modification (*Re-visioning*): Experience with EDI use during the operational use stage creates valuable knowledge. This knowledge coupled with the changes in the global environment may open new opportunities, which may require a critical appraisal of existing vision, perhaps even formulation of a new vision. For example, Singapore now has a new vision of an intelligent city as defined in its new IT2000 plan (Soh et al, 1993).

Technological Infrastructure Upgrading: New developments in the technology (such as multi-media messaging) may help identify new opportunities for EDI use (such as electronic graphic communication in construction and health-care industries). Thus monitoring of new developments in technology and planning for improving the infrastructure is critical to successful strategic use of EDI.

International EDI Liaison may help in joint discovery of new opportunities through global alliances and other inter-organisational mechanisms. Such liaison could be between the level of national and international EDI co-ordinating bodies.

Strategic EDI Planning: EDI diffusion should be monitored by government bodies, user associations or other co-ordinating bodies through routine surveys of EDI use (Clarke, 1994; Masson, 1992). With the increasing level of EDI maturity, it would be necessary to carry out strategic planning for identifying innovative use of EDI as dictated by the new vision and consequent need for a change in the infrastructure.

EDI Expertise Management: With the increasing levels of EDI maturity and expertise, there would be a need to manage this expertise effectively for growth and diffusion among other users. Diffusion of expertise could take place through publication of case studies (Swatman, 1994) and consultancies.

Structural Change in Industries: EDI use may change structure of industry-sectors. These changes may be *functional reallocation*, in which functions are transferred among corporations; *architectural re-structuring*, in which some organisations are destroyed and new ones may be created; and *industry redefinition*, in which the entire industry undergoes major changes (Clarke, 1992). For example, construction industry, which is inherently very fragmented, have been found to change structurally with the increasing diffusion of EDI (O Brien et al, 1993). Monitoring such changes and feeding them back into the strategic EDI planning process may give rise to new EDI opportunities or may warn for corrective actions.

CSFs AT THE INDUSTRY-SECTOR/ COMMUNITY LEVEL

There are hardly any global sector-level empirical studies of EDI implementation available. Therefore CSFs at the industry-sector level are proposed here more on the basis of analytical reasoning rather than empirical evidence.

Discovery Stage

During this stage, the choice of sector(s) for EDI implementation is the most important CSF, as different sectors may have different structures, coordination needs, technological maturity, and importance for the country.

Choice of Industry-sector/Community: The choice of industry-sector/ community is critical in two ways: the importance of the sector/community to the country, and its characteristics in promoting successful EDI adoption. For example, in the case of the Netherlands, the VEDI project was initiated during 1989-92 for identifying industry-sectors of strategic importance for Netherlands (van der Net et al, 1992). Similarly trade and transportation were economically important to Singapore and, therefore, they were selected for initial EDI implementation in Singapore (Neo, 1994).

Table 2. CSFs for EDI Implementation at the Sector/Community Level

Critical Success Areas	Stage		
	Discovery	**Operational use**	**Strategic use**
Sector-level strategy development	Choice of sector/community	Strategic thinking in the sector/community	Strategic vision of the sector/community
			Strategic sector/ community level planning
			Industry environment monitoring
EDI technology infrastructure	IT diffusion in the sector/ community	Technology infrastructure support	Technology infrastructure upgrading
IT maturity of businesses			
EDI coordination	EDI co-ordination planning in the sector	EDI co-ordination support in the sector Government support EDI Standardisation	International EDI coordination
EDI education & expertise	EDI education and promotion	EDI knowledge diffusion	EDI expertise consulting
Business culture in the sector	Cultural change	Collaborative needs	Sector/ community structure monitoring

As for structural characteristics, industry-sectors having high *concentration rates* and *coordination needs* are likely to accept EDI more readily (Lobet-Maris, 1994). A highly concentrated industry-sector is dominated by a small number of dominant players, and the degree of concentration is generally expressed in terms of market share. High concentration within a sector reduces the complexity of agreeing the form of electronic trading. Coordination needs vary widely from sector to sector and depend on production processes. General mass production based industries have higher coordination needs compared to those based on flow or project based production (Lobet-Maris, 1994). EDI enhances the efficiency of coordination process through standardisation and long-term business relationships. For example, retailing has a higher level of concentration compared to construction in most countries, and retailing is also based on mass

production whereas construction is project-based. Consequently EDI adoption level is much higher in retailing in these countries compared to that in construction.

IT Diffusion in the Industry-sector: Even in countries where IT diffusion in business is high, it is *not* uniform across all sectors. A sector/community having high diffusion of IT is more likely to have appropriate technology necessary for EDI implementation, and thus more ready for EDI adoption.

EDI Coordination Planning: Fragmented industries need a mechanism or institution to mediate between organisations, negotiating the form of EDI and co-ordinating its implementation. Industry may support EDI by setting-up such mediator organisations, commonly called EDI user associations, and giving them legitimacy through the organisations which support them (Metcalf, 1993). Examples of such associations in Netherlands are ODETTE in the automotive sector and UAC-Transcom in retailing.

EDI Education and Promotion: Lack of common understanding and limited education about EDI, its "business" value and justification has also been identified as one of the major barriers to EDI adoption (Scala et al, 1993). Also, existing EDI education and promotion programmes may be too general for organisations within a specific sector/community. Thus education and promotion programmes specifically customised for a sector/community should be available. Sector-specific EDI user associations could play a major role in accomplishing it.

Cultural Change: Co-operation among business partners can prove very difficult to achieve if different organisations have widely differing cultures. For example, if most organisations perceive transactions in the "paper-form" only, they might go as far as fax is concerned but may not agree for EDI easily. Such differences can inhibit communication and make working relationships hard to negotiate and maintain for the EDI environment

to exist. Thus, there may be a need for changing the business culture, which should be one of the major goals of EDI education.

Operational Use Stage

During this stage some leading organisations, called the EDI *champions*, would have already introduced EDI and the aim would be that the successes of these early adopters should motivate other organisations as well to adopt EDI.

Strategic Thinking in the Industry: Strategic thinking promotes competitive orientation. An industry dominated by strategy-conscious organisations is more likely to adopt EDI as an enabler of organisational strategies; especially if their strategy is based on reduction in the procurement/delivery cycle, or some other comparative advantage.

Technology Infrastructure Support: There is an increasing tendency, specially in Europe, Australia and Asia, for even the largest organisations to use third-party value-added network services rather than to perform the function themselves (Clarke et al, 1992). Lack of such services customised for a specific sector(s) may inhibit EDI adoption in the sector.

EDI Co-ordination Support: The EDI user associations specific to chosen industry-sectors should be in operation in this stage. They have a very important role in several critical areas such as EDI promotion and education in the sector, liaison with government for its EDI related support, promoting EDI standardisation, and overseeing development of technology infrastructure for EDI use in the sector.

Government Support: Departments which directly interface with a specific sector/community should be encouraged to use EDI in order to rationalise their operations. Government should also modify various laws and court-rules, particularly in the areas of evidence and contract, in order to facilitate EDI-based trade.

EDI Standardisation: EDI standards could be proprietary, industry specific, or international (d'Udekem-Gevers, 1994). As EDI becomes increasingly inter-sectorial and international, de facto industry-specific standards, such as ODETTE in European automotive industry, become increasingly restrictive and impede the attainment of international trading. There is, therefore, an increasing trend within sectors to upgrade their standards in conformity with international standards such as UN-EDIFACT.

EDI Knowledge Diffusion: Early adopters of EDI within a sector/community develop experiential knowledge related to managerial aspects of EDI, which could be a valuable learning source for late adopters. This knowledge could be shared through EDI user group conferences and case study publications.

Collaborative Needs: With the increase in EDI adoption, a sector-wide EDI implementation scheme is more likely to emerge (Clarke et al, 1992). This may be partly due to competitors' tendency to move for neutralising the advantage of "first mover" organisations, and partly to industry and regulatory bodies' tendency to perceive a successful EDI scheme as one which is widely adopted and not limited to few organisations (who could retain the competitive advantage!). Although this sector-based *collaboration* might seem to reduce the competitiveness of the sector concerned, *EDI* tends to open up new possibilities for competition among the organisations. Thus, development of co-operative needs benefits the industry's customers, and hence the economy and society as a whole.

Strategic Use Stage

During this stage, the sector/community has matured in terms of EDI use. There must, therefore, be an increasing strategic-orientation within the sector/community and it must open up for international EDI coordination.

Strategic Vision of the Industry-sector: With successful collaboration in operational stage, companies may start thinking of "global competitiveness" rather than a national or regional one; and may facilitate development of a vision for the entire sector. As for example, the shipping and maritime industry may start identifying itself as an "ocean port community" and analyse various alternative strategies to attain EDI integration (Wrigley et al, 1994).

Strategic Industry-sector Level Planning: Developing a vision alone is not enough unless it is supported by strategic sector-level planning for implementing it. For example, Singapore has not only identified critical sectors for its vision of an "intelligent city" in its IT2000 plan, but has also initiated sector-level planning (Soh et al, 1993).

Industry Environment Monitoring: In most industries business environments are highly turbulent. This makes early detection and rapid interpretation of weak environment signals about impending structural change and discontinuities most critical. For example, the shipping industry within the transportation sector is experiencing a change in terms of customers demand (one point service, "door-to-door" delivery), emphasis on safety and environmental protection, and shift towards multimodal transportation (European Commission, 1994). Such environmental change, if monitored continuously, may highlight emerging opportunities for EDI use, such as multimodal transport based EDI networks, etc.

Technology Infrastructure Upgrading: Strategic applications of EDI may demand additional developments in the technological infrastructure, such as multi-media messaging required for electronic graphic communications (EGI) in construction and health-care industries.

International EDI Coordination: As most strategic applications of EDI are global in nature and scope, there may be a need to co-ordinate EDI activities

internationally. Thus, during this stage, the EDI coordination should be extended to EDI coordination bodies for the same sector in other countries/ regions and international EDI bodies.

EDI Expertise Consulting: Strategic EDI applications are often innovative and it would be desirable for other organisations to know about such innovative use in order to enhance the global competitiveness of the entire sector/community. Such knowledge should therefore be disseminated to other organisations through consultancies or case studies for possible replication or even improved innovation.

Industry Structure Monitoring: EDI implementation may impact the industry structure, which should be monitored closely for identifying new innovative EDI opportunities. For example, EDI's impact on construction industry in UK in terms of enhancing the concentration means that rate of EDI diffusion could be enhanced by changing the strategy to one which is more appropriate for a high-concentration sector. For instance, EDI may be used to implement a vertical integration strategy in the construction industry, as in Japan.

EDI IMPLEMENTATION IN SOME SELECTED INDUSTRY SECTORS

In the near absence of empirical studies of industry sector-level EDI implementation, it may be worthwhile to discuss *analytically* EDI technology transfer in some specific sectors on the basis of their structural and economic characteristics. It illustrates how the CSFs may play their role in the implementation process. We will consider three industry-sectors as examples: transport services, retailing, and construction. Transport services is perhaps the most common sector for implementing EDI; retailing is a sector having a high level of IT diffusion and more adopting to EDI generally; and construction is a highly fragmented sector normally considered non-adopting for EDI.

Transport Services

Transport is a crucial sector for the economy of any country. The transport services sector is engaged directly or indirectly in the conveyance of goods and passengers. Direct involvement relates to the actual conveyance of goods and passengers by various modes of transport. Indirect involvement includes services as handling when changing modes, traffic guidance, freight brokerage, storage, customs clearance, etc. The demand for transport depends on the level of national and global economic and social development at any specific time. It also depends on other factors such as the trend towards flexible production methods, e.g. Just In Time (JIT), leading to lower stock levels but more frequent deliveries of lower volumes.

For countries such as the Netherlands and Singapore, transport services is a very important sector in achieving their strategy of acting as a "logistic hub" for Europe and South Asia respectively. Consequently, there has been a continued high level of government support in improving the efficiency of this sector, specially sea transport, through EDI. For example, the port community of Rotterdam has INTIS and many other inter-linked EDI networks, and that of Singapore has TradeNet and PortNet EDI networks to provide highly efficient sea transport services in these countries. Such high levels of support and promotion were necessary because of the fragmented nature of sea transport sub-sector. For the purpose of comparison, transport is not a strategic sector for the UK, and consequently the level of government support for, and implementation of EDI in the transport sector in UK has been relatively lower compared to other sectors such as retailing.

Retailing Industry

For the majority of consumer goods, retailing is the final link in the distribution channel starting from the product manufacturer to the customer. It is a dynamic and complex sector involving a range of organisation types of varying scale. Its structure reflects the

cultural characteristics of the society it serves, and therefore sociological, economic and technological developments would have an impact on retail trade. In many industrialised countries, retailing has a high level of concentration and close vertical links between manufacturers, wholesalers and retailers. Since low inventory levels is a critical factor for competitive success, there has been a relatively higher level of EDI adoption in this sector compared to many others such as construction, clothing, etc. A CSF exemplified by this sector is the relatively high level of IT diffusion. This is because retailing is heavily dependent on many IT products such as electronic article numbering (EAN), bar-coding, point-of-sale (POS) terminals, etc.

Construction Industry

Construction is traditionally divided into *building* and *civil engineering*. Civil engineering mainly involves public infrastructure in other sectors such as transport, energy, etc. Construction sector is a highly fragmented sector (i.e. many similar firms compete for market share) in most countries. For example, the total number of construction firms in Netherlands is 41,000; out of which only 5 to 10 are large, a small number medium-sized, and all the others are small (European Commission, 1994). This fragmentation is due to many factors which result from the diversity of construction technology, customers and market sectors. The need to repair and maintain the existing built environment means the retention of competence in most of the technologies that were ever used in construction. Furthermore, many construction firms specialise in one or a group of related technologies and are involved with other firms only during a particular project as part of the project team. The fragmented nature of the sector is somewhat reduced by long-term business contracts among firms, as in Japan and to some extent in U.S.A.

Construction sector is generally considered to be a leggard sector for EDI technology. This is generally due to the fragmentation but also, at least in Europe, characterised by small-scale firms, due to the tendency to avoid risks and look for short-term profit, and

finally due to a preference for traditional work methods (European Commission, 1994). Therefore, in spite of its strategic importance for countries such as the Netherlands and UK, the construction sector is not so succesfull in implementing EDI as it is weak with respect to several CSFs. IT diffusion is generally low in this sector as most firms are small in size; EDI education has been lacking due to the conservative thinking of most firms; and worst of all the products and parts standardisation is very low (till recently there were hardly any standards available at the construction project level).

However, recently there seems to be a growing tendency towards EDI implementation in countries such as the Netherlands and the UK. In fact, the Dutch government has put in lot of effort in promoting EDI within this sector (Thissen et al, 1992) in spite of the sector's non-EDI adopting nature. This could perhaps be explained by the fact that the Dutch construction market is reasonably large but there are no such large construction firms compared to those in UK, Germany, France and Japan (i.e. Japanese firms operating in Europe) (European Commission, 1994). Thus, the Dutch construction sector is open for large competitors from other European countries, and this vulnerability makes it an important sector for the Netherlands. On the other hand, the construction sector is important for UK because of the large European market which the big firms in UK would like to capitalise on.

A FRAMEWORK FOR GLOBAL EDI TECHNOLOGY TRANSFER

Having described the CSFs for EDI technology transfer at the country- and industry-sector levels and the status of EDI implementation in three industries, we will attempt to conceptualize linkages between these CSFs and the level of adoption of EDI technology. We will primarily focus on the six parsimonious "critical success areas" identified earlier (Tables 1 and 2) rather than the large number of CSFs themselves. Since the second and third critical areas - EDI technology infrastructure and IT maturity of business - both deal with technological issues, they will be combined into one broader category "technology

infrastructure development". We propose a framework of EDI technology transfer which inter-relates the ensuing five *critical success areas*: strategy development, technology infrastructure development, EDI education and expertise, EDI coordination and business culture change (Fig.3).

Strategy development is a critical area in EDI technology transfer because it provides a clear purpose and sets the direction for the entire country or for a specific industry-sector. Traditionally strategy depends on perceived needs/opportunities and after articulated a *vision* and objectives, a strategic plan is chalked out to achieve these objectives. These objectives and the strategic plan may promote the *demand* for EDI technology. Cases of recent EDI successes (e.g., countries such as Singapore, Australia, Netherlands) are almost always associated with the explicit formulation of a strategy. Once a strategy has been developed, it needs to be implemented.

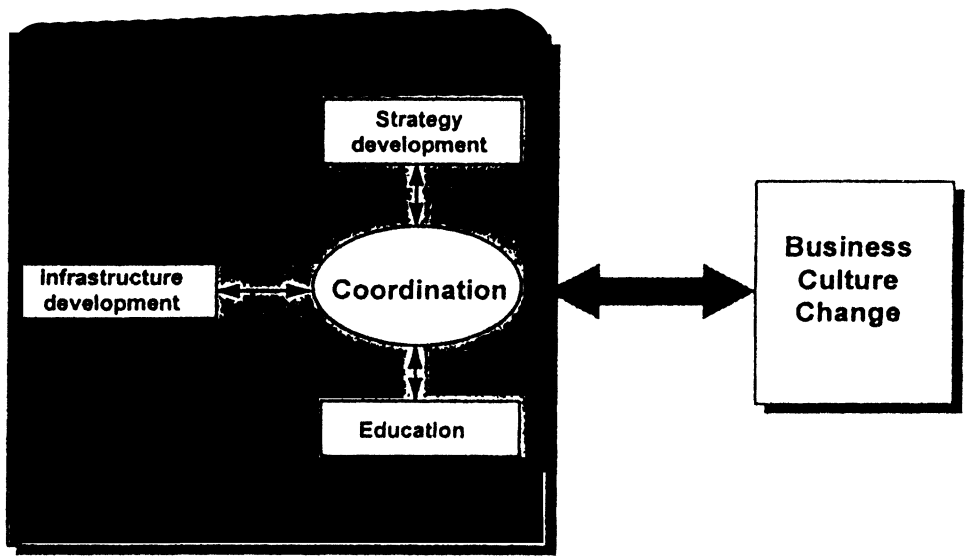

Fig.3. A Framework for Successful EDI Technology Transfer

This requires two things -- the *knowledge/skills* for the execution of various implementation tasks; and the necessary *technological infrastructure* to enable implementation. The three critical areas, which need to be successfully managed simultaneously are: *strategy* development, *infrastructure* development, and *education* (including expertise). This needs effective co-ordination (Malone et al, 1994) of these areas. Therefore the EDI implementation process needs to be coordinated between various stakeholders from governments to international business communities, to industry firms, depending on the level at which coordination is considered. Finally, the outcome of successful EDI implementation should be a desirable change in the *business culture*, i.e. characteristics of the business practices, the business environment and the business people (Randlesome et al, 1993). Thus, at the country-level, the business culture will include characteristics of business environment and practices favouring the willingness to compete internationally whereas at the industry sector-level, it would include characteristics such as basic business philosophy, *trust* in buyer-seller relationships, etc.

Thus, a framework for successful transfer of EDI technology could be proposed for both the country and the industry-sector levels (Fig.3). According to this framework, simultaneous development of *strategy*, *technological infrastructure*, and *education* are the initial critical areas for EDI implementation, which need to be coordinated properly to ensure *success*. Thus the fourth critical area for success is a *mechanism for co-ordinating* strategy development, infrastructure development and education. Without proper co-ordination of the three areas, the transfer of EDI technology may not be successful. The success of EDI technology transfer may be ascertained through the *business culture change* at the level the EDI implementation was planned. The changed business culture would, in turn, facilitate for a deeper transfer of EDI technology by affecting demand for change in the other critical success areas, which is indicated by bi-directional arrows in Fig.3.

To understand the implications of this framework at the country-level (as an example), let us assume that initially the business culture lacks "formalised business relationship". Then, the country would have to develop appropriate strategy, infrastructure and education programmes, and co-ordinate them in an appropriate manner such that the business community develops "formalised business relationships". This would be the "discovery" stage for the country. The changed business culture would now require changes in the strategy, infrastructure and educational programmes in order to move the country into the "operational use" stage. These three areas need to be appropriately coordinated in order to change the business culture further, this time to develop "willingness to compete internationally". This would be the "operational use" stage for the country. Similar action would be required to move the country into the "strategic use" stage, and as explained in Fig.2, may perhaps require much more effort compared to that required for the "operational use" stage. Different countries may require different amounts of effort in different critical areas. For example, in east European countries, business culture change may need more effort compared to countries in the Asia pacific region.

STAKEHOLDERS IN COUNTRY-LEVEL EDI TECHNOLOGY TRANSFER

Having discussed the CSFs at the country-level, the next question is who should have the responsibility for managing them. There are many stakeholders in the EDI technology transfer process at the country-level: the government of the country, IT vendors, EDI user associations, EDI awareness centres, and the industry firms themselves. Each one of these should play an active role in the EDI implementation process by sharing responsibilities for some critical areas which would facilitate effective management of CSFs. These managerial roles of the various stakeholders are shown in Table 3.

From this table it is obvious that the government has some responsibility in *most* of the critical success areas and a major responsibility for strategy development. Countries where governments play such a *pro-active* role are generally more successful in EDI

technology transfer compared to countries where governments play merely a *reactive* or an *inactive* role.

Table 3. Stakeholders' Roles in Managing CSFs at Country Level

Stakeholder	Responsibility area	Relevant CSFs
Government	Strategy development	Perception of EDI need *Envisioning* Vision implementation *Re-visioning*
	Technology infrastructure	Infrastructure planning Infrastructure development Infrastructure upgrading
	Technology maturity	IT diffusion in business
	EDI co-ordination	EDI co-ordination mechanism Regulatory/ legal structure Government use of EDI Strategic EDI planning
	Business culture	Willingness to compete internationally
IT vendors	Technology infrastructure	Infrastructure development Infrastructure upgrading
	Technology maturity	IT diffusion in business
	EDI education	EDI education and promotion EDI knowledge diffusion
EDI user association	EDI co-ordination	EDI standardisation International liaison Strategic EDI planning
	EDI education	EDI education and promotion EDI knowledge diffusion EDI expertise management
EDI awareness centre	EDI education	EDI education and promotion EDI knowledge diffusion EDI expertise management
Industry firms	Strategy development	Perception of EDI need
	Technology maturity	IT diffusion in business
	EDI co-ordination	Strategic EDI planning
	EDI education	EDI knowledge diffusion EDI expertise management
	Business culture	Formalised business relationship Willingness to compete internationally Structural change monitoring *EDI use in business*

EDI technology transfer success also depends heavily on the industry firms who will ultimately be the adopters of EDI technology. They constitute the other most important stakeholder as they also have some responsibility in *all* critical success areas. The more *pro-active* the industry firms in a country, the less effort the government has to make for successful EDI implementation. Moreover, if the industry firms have some dominant big players (as in high concentration industries) who perceive a pressing *need* for EDI, they can pressurise a reactive (or even an inactive) government to at least facilitate transfer of EDI technology by managing CSFs which no other stakeholder can manage, such as "regulatory/ legal structure".

Application of EDI Technology Transfer Framework to Selected Countries

In this section, we will apply the above framework to some of those countries which have either already adopted EDI technology or are trying to adopt it, such as Singapore, Hong Kong, Australia, Netherlands, Greece, Slovenia, etc. In addition to the five critical success areas identified in the framework, another factor, presence of *dominant* (such as large multinational) organisations, has also been included here because, as explained above, their presence could overcome weakness (if any) in the strategy development area. This has been done in order to show what could happen when the technology is available but a national strategy is missing (as in the case of Hong Kong)! In such a case the dominant industry firms could also pressurise their trading partners to have private EDI links with them for continuation of the partnership. The relationship between the critical success areas and EDI implementation success in example countries has been shown in Table 4.

From Table 4, it appears that strategy development plays the most crucial role in successful EDI technology transfer, as in the case of Singapore, Australia and Netherlands. This may be because in the absence of proper strategy, there may not be a proper evaluation of the technology infrastructure and educational requirements and, therefore, any weaknesses in these areas may not be even noticed. However, if an explicit strategy and IT policy are being articulated, plans for developing or upgrading the

infrastructure as well as educating the business community could be initiated as in the case of Greece and Slovenia.

Table 4. Application of EDI Technology Transfer Framework: A Multi-country Perspective

	Singa-pore	Hong Kong	Austra-lia	Nether-lands	Greece	Slove-nia	Colum-bia
National EDI Strategy development	Yes	No	Yes	Partial	Evolvin g	Evolvin g	Yes
EDI technology infra-structure	Yes	Yes	Yes	Yes	Limited	Limited	fast developing
IT maturity of businesses	Yes	Yes	Yes	Yes	Limited	Limited	Limited
EDI education & expertise	Yes	Yes	Yes	Yes	Limited	Yes	Yes
EDI coordination	Yes	No	Yes	Limited	NO	Limited	Yes
Pressure from dominant industry firms	Limited	Yes	Yes	Yes	Limited	NO	Limited
EDI technology transfer	Success-ful transfer	Limited; private EDI	Success-ful transfer	Success-ful transfer	Limited slow transfer	Limited slow transfer	Limited fast transfer

In countries having developed strategies, EDI implementation would be successful if other critical success areas are properly managed, as in the case of Singapore and Australia. A particular interesting case is that of Columbia: encouraged by a well articulated national EDI strategy and telecoms deregulation policy, EDI technology is currently transferred at a high pace (over 4000 users have been reported). This case confirms the importance of developing a national stragegy in the successfull transfer of EDI. However, in countries where development of strategy is weak, evolving or non-existent, presence of dominant industry firms become more important in order to

pressurise government for necessary infrastructure (as in the Netherlands) or to pressurise their trading partners to have private EDI links for continuation of business with them (as in Hong Kong).

PLANNING FOR EDI TECHNOLOGY TRANSFER

The nature of required co-ordination varies during different levels of EDI maturity. Therefore, the EDI technology transfer should be conceptualised as a "staged" process for implementing EDI. Such an approach seeks to strike a balance between strategy development, education and expertise development, as well as technology infrastructure development. Therefore, the planning for EDI technology transfer should be carried out in the following stages: (a) initiation (*discovery* level), (b) institutionalisation (*operational use* level), and (c) exploitation (*strategic use* level). The tasks and the stakeholders responsible during the three stages are shown in Tables 5, 6 and 7.

Table 5. Planning EDI Technology Transfer: Initiation Stage

Responsible Stakeholder(s)	Tasks
Government	• Define strategic scope, scale and direction. Clarify the strategic direction and target technological infrastructure. Develop a vision and determine the strategic objectives. • Decide on the scale of infrastructure change required and the core industry-sectors for EDI implementation. • Set up an EDI coordination body (or bodies) such as EDI user association, EDI awareness centre, etc.
EDI user association EDI awareness centre	• Raise awareness of, understanding of, and interest in EDI.
Government, IT vendors, Industry firms	• Promote IT diffusion in core sector businesses (if necessary) through education, training, subsidies, and consultancies.

It is obvious that the government initiative plays a very important role during the "initiation" stage in terms of defining the strategic direction, changing the infrastructure,

and establishing a co-ordination mechanism. Thus, without strong government support and leadership, EDI technology may not take-off on a large scale in a country!

Table 6. Planning EDI Technology Transfer: Institutionalisation Stage

Responsible Stakeholder(s)	Tasks
Government	• Undertake necessary changes in the regulatory and legal structure (e.g. deregulation of telecommunications, modification in the contract law, etc.).
Government, EDI user association, Industry firms	• Initiate EDI standardisation at least for the selected core sectors.
Government/ IT vendors, EDI user association	• Develop EDI infrastructure (e.g. reliable telecommunication networks and VAN services).
EDI user association, IT vendors, Industry firms	• Promote EDI use in core sectors through training programmes.
IT vendors, User association	• Provide EDI support technology and services.
Government, EDI user association	• Introduce EDI in government, at least in those departments which interface with core sectors.
EDI user association, EDI awareness centre, Industry firms	• Diffuse EDI experiential knowledge through EDI user group meetings and conferences as well as publication of case studies.

During the institutionalisation stage, the role of EDI user association and awareness centre becomes more important because of the need for effectively coordinating the EDI education programmes as well as development of technology infrastructure such as EDI standardisation, etc.

Finally, during the exploitation stage, the industry firms need to play an active role in perceiving themselves as a "community" rather than merely as an industry, serching for innovative opportunities involving EDI use, and more important, acquiring the necessary skills and the technology for the desired innovative EDI use.

Table 7. Planning EDI Technology Transfer: Exploitation Stage

Responsible Stakeholder(s)	Tasks
Government, EDI user association	• Plan for liaison with international EDI bodies.
Government, EDI user association/ IT vendors, Industry firms	• Develop international EDI links.
User association, Awareness centre, Industry firms	• Monitor EDI expertise through sector-specific user group meetings and seminars.
Government, EDI user association, Industry firms	• Ensure a continuous review of EDI achievements and opportunities world-wide through national and international user conferences and industry delegations.
EDI user association, EDI awareness centre, Industry firms	• Monitor core industry-sector structures through industry surveys to assess EDI impact and potential for new sector-specific EDI opportunities.
IT vendors, EDI user association, Government	• Maintain EDI technological infrastructure through *continuous incremental improvements* as well as occasional fundamental changes to it.

CONCLUSION AND FUTURE RESEARCH DIRECTION

EDI is a sophisticated technology which has shown significant impact at multiple levels -- country, industry-sector, and individual organisation. Therefore, a holistic understanding of EDI technology transfer process requires an understanding of the issues to be addressed and the success factors at the three levels. This chapter has proposed a general framework of EDI technology transfer, which fulfils this need because it takes into account these multiple levels and identifies the CSFs at the first two levels. The framework gives an insight into the key areas to be managed for the successful transfer of EDI technology into a country or an industry-sector. Furthermore, the chapter also describes a planning approach for EDI technology transfer, which is based on the framework, and could be used for formulating or evaluating the EDI implementation strategies of a country and/or industry-sector by the policy planners. It can also be used by the senior IS management of multinational corporations for planning EDI implementation in their subsidiaries in

different countries. Empirical research involving detailed case studies at the country level, is being planned to validate the framework and the role of stakeholders in these countries (using data from a much larger population of countries) and thus will enhance its value even more.

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