Managerial Considerations to Adopting Electronic Data Interchange

Trung T. Pham

DIcentral Corporation

tpham@DIcentral.com

Abstract

This paper outlines the process of adopting electronic data interchange into a business cycle and the issues encountered in the process. These issues are categorized into technical, financial, scheduling, and ethical areas. Real-life case studies are presented to illustrate the difficulties of adopting electronic data interchange. Common-sense experiences from these case studies are summarized as strategic moves that might be helpful in avoiding the pain that others have already experienced.

1. Introduction

Electronic data interchange [1-3] is the process of using computers and computer networking to exchange data between two organizations conducting a business transaction. The main objective in using electronic data interchange is to improve *work efficiency* in order to maintain (or to neutralize competitors') competitive advantages. Work efficiency is normally measured in terms of the amount of effort involved in creating a volume of revenue flow in a given time. Therefore, improving work efficiency requires at least one of the following: minimizing effort, maximizing revenue flow, and minimizing the time duration of a business cycle of a transaction.

A business transaction [4-7] is an activity concerning commercial trading where goods or services are sold for a certain monetary amount. A business cycle of a business transaction consists of several interactive steps to be carried out by both organizations involved in the process. It is common practice for businesses to perform the monetary transfer as the last step in this business cycle. As the result, organizations prefer to complete the cycle of a business transaction as quickly as possible to speed up revenues.

Since money is involved in business transactions, acceptable accounting practice [8-11] must be established to accurately record them. The *accuracy* of accounting data has been improved tremendously with the use of computer and specialized accounting software. However, accounting software is only as accurate as the data entered by human user. Most of the time, data that initiate a business transaction set up by one organization can be reused by the other organization involved in this transaction. The practice of requiring humans to re-enter this data into another computer system is completely eliminated if data is transferred electronically from one computer (in an initiative organization) to another computer (in the receiving organization). Eliminating data re-entering will reduce the effort involved and improve accuracy that was often hindered by human error. Transferring data electronically also eliminates the time required to mail the paper containing the printed data.

Adoption of electronic data interchange [12-15] is the process of setting up computer and computer software to allow data sharing between two organizations conducting a business transaction. This process consists of connecting computer networking, establishing data format, agreeing on data protection procedure, and following a data redundancy routine. In addition, data importation into specific computer software must also be established to eliminate re-entering data.

The process adopting electronic data interchange is categorized into two classes: *symmetric* adoption, and *asymmetric* adoption. Symmetric adoption is the process involving two organizations [16-18] of equal size and of compatible resources. This adoption often focuses on technical commonality between two computer platforms. Asymmetric adoption involves two different organizations of vastly different sizes and with unequal resources. This adoption often focuses on the economical feasibility as well as the technical feasibility of the (much) smaller organization.

This paper presents the steps of the adoption of electronic data interchange, then outlines both economical and technical issues encountered. These issues are analyzed, with special emphasis in the asymmetric adoption. Real-life case studies are provided to illustrate these difficulties, and for each case, a real-life solution is detailed.

2. Adopting Electronic Data Interchange

2.1. Settings.

As companies are looking to cut operating cost, adopting electronic data interchange (EDI) became one

viable option to address this criterion. However, EDI adoption involves at least two organizations and the implementation can only be carried out if both sides agree to this common goal. Therefore, inter-organization behavior [19-23] must be taken into consideration in effectively planning and carrying out the task.

There are two unique scenarios in the multi-organization settings: *symmetric* relationship, and *asymmetric* relationship. Symmetric relationship is the scenario in which two organizations are of equal size, with similar resources, and having equal leveraging power. Asymmetric relationship is the scenario in which two organizations are of vastly different sizes, unequal resources, and with one organization exerting uncontested leveraging power over the other.

In the EDI adoption for companies in a symmetric relationship, both must agree, in principle, to the initiative. In general, both organizations normally have deep resources to carry out this initiative; the only remaining issue is to define a common data format so that both will comply to. If both organizations are using the same ERP system, the technical requirements become simpler. However, it is likely that they use different ERP systems, each being set up differently. In this case, both sides must compromise and agree to a common format that distributes the effort equally. Otherwise, individual organization normally prefers the minimum effort approach of using the existing default setup of its ERP system while expecting the other to change their setup. Unfortunately, in a symmetric relationship, both sides would want to use this approach and let the other side do all the work, causing a need for a compromise.

In the EDI adoption for companies in an asymmetric relationship, the larger company, normally with tremendous leveraging power over the other smaller company, will take the initiative and pressure the other company to comply. In this case, the larger company will define technical requirements around its ERP system's capability to export and import data. A solution is then forced down to the smaller company to comply if it wants to continue the trading. In this case, the smaller organization is at the disadvantage of having no input on defining the technical requirements that definitely will impact their system. In addition, the small organization might not even have the option of selecting a viable solution that addresses both the cost and ease-of-use issues.

2.2. Symmetric Adoption.

The symmetric adoption can be initiated either by the top-down or bottom-up approach.

In a *top-down* approach, visionary officers of a company would initiate a new policy requiring a change in the way it is conducting trading business with its partner. This new policy must be in synchronization with that of the trading partner. The policy is then concurrently enforced down to the technical workers in a revolutionary way.

When EDI adoption is carried out in the top-down approach, all the steps are carefully planned together so that an optimal solution is achieved under the best circumstance. Intuitively, this process is often viewed as an optimization process designed to yield an optimal solution. The main issue left is the implementation of the solution that is often carried out with managerial monitoring and controlling.

In a multi-organization environment, an implementation process can be carried out with full interaction at all levels. The managerial monitoring and controlling are still carried out concurrently at the top levels where a communication bridge is built to channel work requests and to resolve conflicts between two organizations. The work requests must follow some established line of commands to avoid the perception of one group of an organization is dominating another group of the other organization. The resolution of conflicts must be objective and following the compromising path (instead of yielding path) to ensure the symmetric relationship.

From a managerial perspective, when two organizations are working closely together, there is always a possibility of one organization raiding the other's talent base in its recruiting effort. Since the talent base is often considered an asset to a company, the objective of protecting its asset must be clearly defined and followed in any cooperative work arrangement. Some general practice emphasizes on the cooperative agreement between two organizations agreeing not to actively recruit the personnel involved for some fixed time period. Other emphasizes on having each employee agreeing to a non-compete contract restricting his/her lateral movement in future employment against specific companies.

Another aspect of inter-organizational cooperation is the protection of intellectual properties. In an inter-organization cooperation to share data, some proprietary information, i.e., work-flow process, system design, data format, data usage, and in-house customized development, might be disclosed in order to establish some commonality. Classic legal cases of infringement on intellectual properties must be carefully examined and all possibilities be clearly addressed.

In a *bottom-up* approach, technical workers with commanding knowledge would propose incremental changes in an evolutionary way toward making their jobs easier. These changes, most of the time, can be carried out effortlessly. However, if the changes impact on others in the same organizations or in the other organizations, the change must go up through a line of command to get endorsement and approval.

When EDI adoption is carried out in the bottom-up approach, the regular working process is gradually modified with incremental steps designed to minimize impact to the normal operation, and often time, minimize visibility to upper management level. This way, the process is carried out with no requirement of approval from top management, avoiding layers of bureaucratic approval requests often dreaded by the practical engineers with a single objective of making the system work in a simpler way.

In this bottom-up adoption, most of the time, all the incremental steps are not carefully planned together. In general, a technical engineer often realizes that a simple modification to the system he is in charge of would make the work process a lot simpler for the users. This modification can be either an acquisition of inexpensive software to run as a complementary component of an already existing system, or the development of a simple program to streamline data faster, or the rearrangement of hardware and software to simplify the dataflow. In each case, this engineer probably would go ahead and carry out this new change with almost no need to request for approval from the upper management. When there is a negative impact on the other organization, this engineer would seek meeting with his counterpart at the other organization and plan out necessary work to resolve this impact.

The incremental changes are often driven by a single objective of simplifying a working process. Even though each change might be planned and carried out independently of other changes, the process gradually moves toward the final goals. Intuitively, this process is often perceived as sub-optimal because each step was independently designed to bring the system to a local optimal point. The final goals are achieved potentially at a longer path than that with all steps planned coherently.

2.3. Asymmetric Adoption.

The asymmetric adoption of EDI normally is initiated by a large organization managing a large number of small trading partners. A specific example of this asymmetric relationship is the buyer-suppliers arrangement, sometimes known as supply-chain management. The buyer, often times a large distributor, reseller, or retailer, buys volume of products at steep discount price from individual suppliers to retain the pricing competitive advantage. In order to drive down the cost of inventory management and the shelf-life cycle, buyers turned to electronic data interchange for placing orders, receiving invoices, making payment, tracking shipment, and managing received goods. These activities are solely designed to help the buyer's competitive advantages. The suppliers' concerns, especially the ones with exclusive

selling agreements, are mainly to sell their products and to collect money payment.

In this asymmetric adoption, the activities are planned around the large corporation's ERP system with as little modification, additional development, or impact as possible. The burden of compliance is distributed to the suppliers. This mandate is normally possible because of the buying leverage a large organization has over a small supplier. The suppliers have little choice but to comply in order to continue the trade. This compliance often results in an increasing cost for using EDI, and subsequently, a silent resistance or resentment.

One major emphasis in adopting EDI for a large organization is the minimal impact. This objective often drives the large organization to centralize the technical implementation to an outsourcing company to make a complying platform available to these small suppliers on the cost-sharing basis. This approach narrows the technical environment to only one interface with a single platform, simplifying the maintenance while shifting the support to a third-party outsourcing company.

The EDI adoption can be carried out by one of the following processes: phase-in, pilot-program, and big-bang. Phase-in is the process of making one batch of suppliers compliant at a time before moving to another bath. A pilot program is the process of selecting a small batch of suppliers to test the system before moving the remaining suppliers to compliance. Big-bang is the process of moving all suppliers at once toward compliance.

Phase-in process starts with categorizing trading partners (suppliers) into different groups, each group containing partners with similar computer platform and resources. Each group is scheduled to use a particular solution at the same timeframe. This way, if any unforeseen technical problem arises, it will be addressed and massively solved for the whole group to avoid.

A pilot program process starts with the assumption that all the trading partners have the same computer platform and similar limited resources. A small group is selected to test out a particular solution. If this small group successfully adopted with this solution, it can be assumed that the remaining trading partners can be brought in with relatively few issues.

The big-bang process starts with a safeguard of having the overlapping operation of the old system and the new system so that anytime something goes wrong with the new system, one can fall back and use the old system as an emergency relief while the new system is being fixed. This big-bang approach is normally used to force a change in organization where fear of change often impedes progress.

The cost of adoption can be a bottleneck slowing down the process. Instead of a large corporation absorbing a sizeable upfront cost, it is preferable to distribute this cost

to the suppliers so each bears only a small share. However, adding more cost to small suppliers often results in resentment and resistance. Recognizing this behavioral factor, some large corporations implemented a three-phase cost structure: the first phase of adoption paid for by corporate general services administration (GSA) overhead funding, the second phase of adoption paid for by individual departments or groups utilizing the service from their own operating expense budget, and the third phase of adoption paid for by individual suppliers.

3. Issues to Adopting EDI

Adopting electronic data interchange will touch on a few issues that need immediate attention from the start at a planning stage and going through the implementation phases. The first important issue is the question of technical feasibility. This question addresses the topics of what technology is required and whether the adoption is achievable with technological products currently available on the market. Once it is determined that the technical availability is acceptable, the cost of implementing must be addressed. This issue deals with estimation of the total cost, whether it is affordable, and trade-off between cost and projected benefits. Then, a schedule must be prepared to accurately show the starting date and finish date for the process. This schedule must also reflect managerial control toward achieving the milestones listed in the schedule. The timetable is especially important to operational process because there is always severe opportunity cost associating with delaying. Ethical practice must be established to prevent questionable behavior and unnecessary litigations.

3.1. Technical Requirements.

There are three general technical requirements for adopting EDI can be stated with three main points: (i) a data translator to translate data from a format acceptable by a company's ERP system to a format acceptable by the trading partner's ERP system, (ii) an encryption program to protect the data from being intercepted by a third party not authorized to view it, and (iii) a reliable transmission protocol to effectively transmit data and to readily allow detection of transmission failure.

In addition to the three basic technical requirements listed above, each company might require additional features customized to its business process. For example, a company might require printing out an advance shipment notice and shipping label with barcodes capability, or a customized documentation tracking system to help them monitor the routing of the goods in transit. These customized requirements are individually defined by each company conducting business in a certain vertical market and following specific business rules.

Data translator software can be acquired as off-the-shelf software. However, this software is not a simple program that one can install with a few clicks of a mouse button. The translator software normally requires extensive setup to specify the data definitions for translation and data ranges for validation. This typical setup must be performed by a specialist who knows the operation side of the translator software, the technical side of the data definition, and the business side of an organization. The set up requires duration in the order of months--widely accepted in this industry--to complete. A data translator can also be developed from scratch but will involve a lengthy development time.

An encryption program can also be acquired as off-the-shelf software. There are well-known and generally accepted encryption algorithms that protect the data well. These algorithms are easy to implement. However, the difficulty in dealing with encryption is the management of security keys designed for this encryption purpose. Off-the-shelf encryption software is specifically designed for this key management purpose. As the result, the general practice in data protection is to use well-known algorithm that comes with off-the-shelf software: the well known algorithm has been tested and accepted with established difficult-to-break statistical measurement to ensure a level of security, and off-the-shelf software allows timely implementation and effective management of security keys. In addition, many newer encryption algorithms were also designed to detect data tampering by using parity checking to increase the comfort level for the users.

A transmission protocol is the way of transmitting data from one computer system to another computer system. In B2B e-commerce, this transmission must be established between two companies. The transmission protocol must allow complete data transmission, acknowledgment of receipts, and detection of missing data. Traditionally, EDI data were transmitted through a dedicated link between two organizations to prevent any data tampering. As technology evolves, valued-added networks (VAN) were introduced to serve this transmission function. Recent development of the Internet technology and the availability of well-defined encryption algorithms initiated an alternate, and perhaps less expensive, transmission protocol for EDI data.

In symmetric adoption, two organizations of equal leverages will decide a common technical requirement that distributes the amount of effort and required resources equally among them. However, in an asymmetric adoption, the larger organization, normally with strong leverage over the small organization, will take lead in deciding the technical requirements and force the smaller organization to comply. In this scenario, the larger organization will decide that the smaller organization will have to outsource their EDI need to an EDI service provider on the pay-per-usage basis. In this common

practice, the larger organization either selects a sole source provider and forces the smaller organization to subscribe to that EDI service, or registers a list of approved providers and forces the smaller organization to choose one. There are a few asymmetric cases in which the larger organization provides a free service to its smaller trading partners with the reasoning that whatever the cost the smaller organizations pay to a provider will be added to the cost of the products they sell, causing the larger organization to indirectly pay for it anyway.

3.2. Economical Requirements.

The general economical requirements for adopting EDI are: (i) affordability, (ii) return-on-investment comfort, and (iii) limiting economical risk factor.

Affordability is the comparison of the actual cost with the allocated budget a company might set aside for the purpose of adopting EDI. For a large company, this budget might often be more than the cost, but for small company, this budget, if exists at all, is often less than the cost. Two alternate options addressing the affordability issue are: the installment plan and the pay-per-usage plan.

The installment plan allows a company to spread out its financial obligation over a long period of time. In this particular scenario, a company will acquire the EDI software satisfying all technical requirements and start the operation. It will pay for the cost on a monthly basis over a duration often designed to cover the life-cycle of the software. This option is sometimes known as the mortgage plan.

The pay-per-usage plan allows a company to lease a software license or to lease a service from a third-party provider. The company will pay, mostly on a monthly basis, for the duration that it uses the software or how much it utilizes the service. This way, the company does not own the software and must renew the license after the agreed duration, or continue to pay the service provider for the service. Even though the software is not owned, the company is limiting it risk associating with software obsolescence, cost of maintenance, and initial cash outflow.

Return-of-Investment is the trade-off of how much one saves (or benefits) compared to the investment one must make. In the case of adopting EDI, the benefits are measured in terms of saving the cost of manual labor. The common sense approach requires that the cost of doing EDI must be less than the cost of conducting business the normal way. However, for small companies, sometimes the cost of doing business the normal way is not measurable because of the unlimited availability of a person, typically a spouse of an owner, to conduct trading via fax and telephone machines. Assuming the best-case scenario in an extreme case like this where the cost is measurable, one must also compare the cost of doing EDI against the profit margin for each transaction. If one must pay an amount, say a dollar, to send an EDI transaction that generate the same amount of or less revenues, the adoption of EDI does not make sense.

Limiting economic risk factor is a measure preventing the maximum potential loss to an acceptable level. This factor is particular important for a company electing to outsource its EDI operation to a third-party service provider. The worst-case scenario for this option is that the service provider goes out of business. The potential loss, in this case, includes initial setup fee, prepaid amount, and loss of business in the period of transitioning to a new service provider. In some case, there is an additional hidden cost associating with recovering the data definitions if the defunct provider would not provide any document to help the new provider implementing the service setup. This cost consists of duplicated effort to obtain the data definition, loss of business during the data definition recovery period, and cost of monitoring the new implementation.

In order to limit the economic risk factor, large companies outsourcing to a service provider often require a healthy financial statement showing the provider's capability to remain in the market for a minimum period of time. In addition, these companies also require documentation of data definition and a contractual requirement mandating the provider to provide the software for them to use at some cost in the event that the provider goes out of business.

In asymmetric adoption, the larger organization is well protected whether it chooses to support itself or outsource the work to a provider. However, the smaller organization is often at the disadvantage of complying with the larger organization's EDI initiative with little or no authority to consider what is best for its future.

3.3. Scheduling Requirements.

In symmetric adoption, scheduling is defined to fit both organizations' comfort. In asymmetric adoption, scheduling is often imposed by the larger organization on the smaller ones. The larger organization, because of having to manage a large number of suppliers, will have to design a schedule that minimizes the impact of its normal business while gradually adopting EDI initiative.

The criterion of minimizing impact often results in a batch scheduling: one group of suppliers is selected at a time to implement a particular solution. The selection of these suppliers can be prioritized based on the volume of trading, the frequency of trading, or the readiness of EDI compliance.

3.4. Ethical Requirements.

With the current scandalous atmosphere in accounting practices that led to the downfall of many large corporations, there are a few ethical issues of concerns in asymmetric adoption of EDI. In this asymmetric adoption, when the larger organization chooses to outsource their EDI work to a provider or already subscribed some services from a provider, this provider sometimes offers a steep discount on this outsourcing work (or certain already-subscribed services) to the larger organization in exchange for being selected as a sole source provider to a large number of suppliers. These suppliers will be forced to use only one "approved" provider at a high cost that bears the additional burden of the discount given to the larger organization and, often times, an add-on premium to that sole-source provider to bolster the provider's profit margin. This practice is not ethical because the discount is not a true discount: someone else will be forced to pay for it, hiding the true cost of outsourcing or utilizing certain services. In addition, the sole-source selection that results in high premium service charge often poses the image of practicing monopoly in the land of free competition.

Another aspect of adopting EDI that might pose as an appearance of conflict occurs when the larger organization selects a technical solution provided by a provider practicing a lock-to-prevent-entrant-by-competitors tactic. In this case, the EDI solution is partitioned into a server-client model: the larger organization would be given free server software (or at a nominal fee). This software only allows communications protocols with the corresponding client software through secret proprietary data exchange sequence. The client software is sold at an exorbitant price to an EDI provider or to individual small suppliers being forced to comply with the EDI initiative. In this scenario, again, the larger organization can hide the true cost of implementing EDI software in the increased cost of the products they buy from these small suppliers.

In general, ethicality is an issue that is not well defined. The practice of avoiding ethical misconduct is often vaguely described by each organization's statement of ethicality. This vagueness leaves the responsibility to individual interpretation. Therefore, it is always a good practice to find a minimum common denominator set by the legal boundary and ethical boundary, subtracting a safety buffer to filter out the debatable areas, to derive a set of specific guidelines designed to be fair, legal, and ethical. In addition, avoiding the appearance of being unethical is as important as avoiding being unethical because it will eliminate suspicion and establish a healthy atmosphere.

4. Case Studies

In this section, five unique cases are presented for five different companies trying to adapt electronic data interchange so they can continue trading with their trading partners. The struggles are different but the aggravation that each endured all reached similar excruciating levels. The positive results are presented at the end of this section, along with generalized practice of strategic moves for others to minimize impact when having to go through similar experience.

4.1. Bajamar Chemical Co. Inc.

Bajamar Chemical Co. Inc., located in St. Louis, Missouri, is a small pharmaceutical distributor that provides a number of generic prescription potassium supplements to drug wholesalers, distributors, and chains on a nationwide basis. Up until 3 or 4 years ago, the company exchanged purchase orders and invoices with all of its customers either by mail or fax. At that point, some of the larger drug chains and wholesalers began EDI initiatives, requiring their vendors to be EDI capable in a relatively short period of time.

While it was not a problem for larger vendors to adopt EDI, most of the smaller to medium size vendors, such as Bajamar, did not have IT staffs that could develop their own in-house EDI applications. To assist these small to mid-sized vendors, many of the large drug chains and wholesalers have developed partnerships with EDI software and services companies to offer relatively inexpensive, web-based, turnkey solutions.

Bajamar's situation is delicate: it had no budget to staff up an IT department to address its specific needs, and the alternative path of outsourcing its technical work to a service provider was either inadequate with one provider or too expensive with a combination of outsourcing and acquiring customized software. The Vice President, Mr. Barry Mize, who was in charge of this task, put forth a simple list of requirements while searching a suitable provider to outsource the company's IT work:

- Competent customer service and technical support staff to make the transition as smooth and painless as possible.
- Integration of UCC-128 barcodes that are generated from within the EDI software itself.
- Automatic generation of Advanced Shipment Notice document using data extracted from the Invoice to save time, prevent errors, and eliminate the need for a separate program.
- Catalog feature to store and update the company's product catalog effortlessly.

Unfortunately, most of the available solutions had been bare-bones products that met the minimum requirements of the vendor but were extremely difficult and

cumbersome to use. Many of these so-called solutions were literally nothing more than a collection of independent forms that were not integrated with each other such that data must be repeatedly entered manually into each document. In addition, these systems typically did not provide UCC-128 barcode printing, so one must find other software for this requirement and manually enter data from one system into the other. Between the redundant, manual data entry and the separate barcode generation, these solutions encourage data entry errors and increase vendor costs, which undermine the entire point of using EDI.

4.2. Computize, Inc.

Computize is an enterprise founded in 1983 with headquarters in Houston, Texas, and multiple locations throughout the United States. Computize is in its seventeenth year of steady growth by selling technology products such as computers, monitors, printers, scanners, software, and other accessories through online channels and traditional phone sales. Computize always has made strong commitments to developing business-to-business (B2B) e-commerce solutions designed to accommodate the unique needs of its enterprise customers.

In recent years, Computize has transformed from a traditional telephone and fax operation into an Internet-based ordering and fulfillment company. Customers can search and order from thousands of products online. However, this solution is not complete because of the lack of back office integration with the business partners (suppliers). In seeking ways to differentiate itself competitively, Computize recognized that the efficiency of a supply-chain directly affects its productivity, and profitability. Therefore, a goal of 100% electronic supply-chain was established to move the company forward.

The company pursued traditional EDI, but quickly realized that maintaining separate EDI maps, communications, and security for each of its customers and suppliers was not cost effective. In these early years, Computize must allocate, on the average, six months of one full-time technical engineer to setup the trading path with one trading partner. In addition, it must invest sizeable amount of money in EDI software acquisition to synchronize with its trading partners.

The initial investment in setting up trading paths is not the only cost Computize must bear. It must maintain a database of data definitions that each of its trading partner is using. Each time a trading partner is upgrading its system with new requirements or modifying existing requirements, Computize must suspense its trading to accommodate such changes. To make matter worse, each time Computize is upgrading its system, it must notify all of its trading partners for adjusting to new changes.

The company's owner, Dr. Sam Ryu, wanted to cut down the cost of maintaining an EDI system capable of connecting to different ERP systems and different data definitions. As the company moved forward implementing more connection with new trading partners, the cost mounted up exponentially. Dr. Ryu wanted to focus on the core business of profitability on reselling technological products instead of pushing its effort on implementing EDI.

4.3. Atlantic Cable International, Inc.

Atlantic Cable International, Inc. is a wholesale distributor of telecommunications and electrical wire and cable to major corporations worldwide. Incorporated in 1982, it has been owned since 1985 by its current President, Bernadette Dorsey. The company sells electrical cables for offshore rigs, telecommunications installation equipment, electrical cables for cranes, and commercial marine cables. It maintains a large product stocking facility in Houston, Texas, and a sales office in the United Kingdom.

Of Atlantic Cable's more than 250 customers, the largest fifty percent prefer to do business with companies who are prepared to provide a minimum set of EDI/XML transactions, usually starting with the basic purchase order and invoice. When these enterprise customers (such as Southwestern Bell, Ameritech, Pacific Bell, etc.) started to pressure Atlantic Cable to comply with EDI/XML standards tailored more to the systems and needs of large corporation, Atlantic Cable found itself facing an electronic commerce "glass ceiling."

In order to comply with these large-enterprise EDI requirements, Atlantic Cable must spend an equivalent amount of investment on computer software and initial consultants to set up the software. To each large enterprise, this amount is only an extremely small fraction of their budget, but to Atlantic cable, this amount is prohibitive. In addition, cost-containment is vitally important to smaller enterprises without a large EDI/XML implementation budget. Every expenditure is part of a delicate balance between attracting larger customers and the expense of elaborate consulting and software package solutions.

Like most SMEs, Atlantic Cable doesn't maintain a large staff dedicated to EDI/XML or technology issues, so its electronic transactions are maintained by its accounting department. For smaller companies who have no time to train for the huge learning curve of EDI/XML mapping and systems integration, nor the money to pay for comprehensive software solutions, the B2B e-commerce adoption is frustratingly out of reach.

In addition, Atlantic Cable wanted to integrate its Rubicon ERP system with a B2B solution in order to maintain inventory and synchronize their accounting

system more easily with its Partners. Efficiency and speed are the keys in their goal of remaining customer-centric.

4.4. LBMX, Inc.

LBMX (Lumber and Building Materials Expert), Inc. is a wholly owned Canadian company based in London, Ontario, Canada, with activities focused on the Canadian hardware, lumber and building material industry. During the time of e-commerce rapid expansion, its President, Mr. Ian Gray, and other LBMX managers began talking to companies from various stages of the hardware supply and distribution pipeline. They discovered that many were spending as much as $125 to process each of about 20,000 orders they receive each year from other businesses and sometimes employing dozens of people each to do so.

With an open market of about 1,000 suppliers, 20 buying groups and 4,500 hardware dealers across Canada, Mr. Gray saw this phenomenon as an opportunity. The company founders, originally from Dimensions Retailing Systems, Inc., a company that provided point-of-sale computer systems to the building materials industry, founded a new company with mission to providing EDI solutions to the industry and named it LBMX, Inc.

LBMX provides a web-based service that allows any two trading partners to exchange business information electronically regardless of their back-office systems. This service takes information from one trading partner, translates it to the second trading partner's desired format, and delivers that information right where it's needed. In addition, if a partner does not use a system to produce electronic documents, then LBMX will allow that partner to trade electronically using electronic forms or E-forms.

A significant number of buying groups and suppliers in the industry endorse the LBMX electronic data interchange initiative as their solution of choice. LBMX focused on connecting trading partners electronically - suppliers, dealers and buying groups - to reduce costs and streamline business operations.

LBMX Inc. outsourced the technical work of EDI adoption to its parent company that acquired it during the economic prosperity of the late 1990s. However, during the subsequent economic fallout, LBMX found itself going through a reverse merger, splitting from its parent company to become independent again. The level of technical support fell off and the company was left in panic looking for a strategic partner to take over the responsibility of providing a web-based back-office solution for its contracted customers while it continues its mission of capturing the Canadian lumber market.

The requirements for its strategic partner were quite simple:

- A cost-effective solution affordable to the trading partners.

- A true any-format-to-any-other-format translation capability to accommodate the heterogeneous nature of the market.
- Reconfiguration capability to customize to individual trading partners.
- Data protection to ensure that competitive pricing for each arrangement is confidential.

These requirements were established after considerable frustration with the previous provider's inability to allow rapid expansion with a large number of trading partners already committed contractually.

4.5. Baker Hughes, Inc.

Baker Hughes Incorporated is a leading supplier of reservoir-centered products, services and systems to the worldwide oil and gas industry and a leading supplier of separation technologies to the worldwide process industries. This oilfield services company (founded on the back of early 20th-century innovators Baker International and Hughes Tool Company) serves a handful of large companies, like Texaco, Chevron, and Shell, all of which have put considerable effort and resource into EDI.

Baker Hughes used a third-party EDI service provider to manage its data translation and data connection to its trading partners. Early in 2001, Baker Hughes was shocked with the 30-day notice that its provider would permanently shut down their operation and ceases to exist [24,25]. This surprised notice left the company scrambling to look for and select another provider to implement the data translation and data integration with its ERP system, all within a 30-day window.

One major technical requirement for Baker Hughes was the streamlining of its internal business processes around the SAP enterprise resource planning software. In addition, there were different data definitions used by its trading partners that did not get properly transferred when the provider went out of business. This lack of documentation further complicated the situation, especially against the 30-day window to complete the task.

While streamlining around the SAP enterprise resource planning software, Baker Hughes still had to support different ERP systems used in different divisions within the company. This situation arose from many acquisitions that Baker Hughes made. After an acquisition, Baker Hughes normally left the newly acquired company become a new division within the company, retaining its original normal business practice while gradually introducing the corporate culture and practice later on. As the result, there were different divisions in a company employing different ERP systems with different data output formats.

The major requirements that Baker Hughes must address were:

- Complete all tasks within 30 days.
- Secure communications protocols to transmit data and to protect data integrity and data content
- Setting up data translation from IDOC format produced by its SAP enterprise resource planning system and from a proprietary format produced by its PRISM enterprise resource planning system
- Establishing a single data pipeline in supporting the company consolidation initiative

In addition, the outsourcing must satisfy the company's Project Renaissance, a major initiative to achieve significant cost savings by streamlining internal business processes and effectively implementing SAP enterprise resource planning software. Furthermore, the outsourcing company must display proof of fiscal responsibility to assure the company that it will not surprise the company the way the previous provider did.

4.6. Positive Results.

All five cases presented above ended in positive result, with each company finding a solution meeting its objectives and schedule.

Bajamar Chemical Company employed the *trial-and-error* approach, outsourcing [26] through different EDI service providers before settling down for one on the permanent basis. One main issue for this approach is the economics of switching: almost all providers require some initial setup fee, normally affordable to a small company. However, the trial-and-error approach can quickly accumulate the setup fees into a sizeable financial burden. Most of the time, small companies like Bajamar would negotiate with the EDI service providers [27] to waive (or reduce) the initial setup fee as incentive to switch, minimizing the risks to some acceptable level, and pay only on the usage-basis [28].

Computize employed the *diversification* approach, investing in a startup company to develop a platform that satisfies its technical requirements. This approach also allows Computize to manage its surplus cash flow while obtaining a platform best fit to its needs. As investor, the company provided ample inputs on the user's perspective to the founders of the startup company who built the system to serve Computize as its first customer. The startup company in turn, used Computize as a solid reference and moved on to earn contracts with other customers. From the investor's perspective, Computize also benefits from the growth of this startup venture.

Atlantic Cable employed the *customer-loyalty* approach, leveraging a personal friendship with one officer of an EDI service provider to obtain help in integrating its ERP system with the service of that company. Atlantic Cable secured a customized setup allowing it to trade with all the large companies at a significantly cost effective rate [29]. Whenever Atlantic Cable upgrades its computer, it can always count on the friendship and its loyalty to the service provider to obtain free consultation to help it utilizing new technology.

LBMX employed the *alliance-forming* approach, securing a symbiotic partnership with another company to handle its technical need under a private-label [30,31]. LBMX would deliver the customers while its partner would deliver the EDI service. The profits were equitably shared on a pre-negotiated rate. This arrangement allows LBMX to focus on its marketing strength and its leadership in the Canadian lumber market segment. Its strategic partner receives a steady influx of customers with zero sales and marketing effort in this Canadian lumber market segment while directing its effort in capturing market share in other vertical sectors.

Baker Hughes employed the *pilot-program* approach, outsourcing the EDI work of two departments to a provider carefully selected in a competitive open bid designed to be ethical [32] and risk containing [33], driving the aggressive delivery schedule on the perception that there would be more work to come if the performance of the EDI provider met its vigorous requirements in this pilot program.

5. Conclusion

Adopting electronic data interchange requires thoughtful managerial planning and effective control. For symmetric adoption, the adoption is centralized at resolving technical differences between two organizations and focusing on the correct line of commands to coordinate work and to resolve conflict. For asymmetric adoption, the controlling measure is seized by the larger organization, giving a perception that the process is significantly simplified. However, inadequate resources and the heterogeneous nature of a chain of small organizations complicated the adoption process to a point that at some stage in the actual implementation process, the large corporation must put itself into the shoes of the small organizations being forced to comply so that it (the large organization) understands the behavior of small organizations and therefore could effectively plan and carry out the process. Case studies have shown that behavior of small organizations requires this delicate treatment.

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