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THE BENEFITS AND CHALLENGES OF ELECTRONIC DATA INTERCHANGE

Implementation and Application at Kilindini Water Front Project in Kenya

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Abstract

Many organizations are applying Electronic Data Interchange (EDI) to improve operational efficiency, enhance information quality, and achieve reductions in processing time of critically important business information. EDI today represents an opportunity to improve business processes and business controls directly even though challenges are expected. It is in light of the opportunities and challenges that this study is done, specifically focusing on the benefits and challenges of implementation and application of EDI in Kenya considering the case of Kilindini Waterfront Project. Data was collected from 45 managers of the firms selected using convenient sampling. The respondents were asked about perceived benefits of EDI application and perceived challenges of EDI implementation and application. The questionnaires were mainly hand delivered to the respondents. The data collected was analyzed with the use of frequency tables, proportion, percentages, cross tabulations and factor analysis using SPSS. Majority of the firms that were studied had less than 1,000 employees which may possibly mean the firms are less labor intensive and therefore relying more on automated processes. This study also show that most of the respondents were experienced with EDI implementation and application and therefore had the necessary knowledge sought for. From the factor analysis carried out on the variables of the benefits of EDI application, the deduction drawn indicates that firms that apply EDI benefited. Some of the benefits include reduced errors, access to information, enhanced competitive capacity and improved trading partner relationship. Despite the benefits of EDI application, it was also found that there are several challenges encountered in the implementation of EDI. From the factor analysis carried out on the variables of the challenges in the EDI implementation, the deduction drawn indicates some of the challenges to be lack of top management support, negative staff attitude, inadequate IT staff training and inadequate non IT staff training. This study also indicated that there were challenges encountered in the application of EDI. From the factor analysis carried out on the variables of the challenges of EDI application, the deductions drawn indicate some of the challenges to be inadequate non IT staff training, lack of trust of other EDI partners, lack of flexibility, lack of maintainability and lack of awareness of benefits of EDI.

Keywords: Implementation, Benefits, Challenges, Electronic Data Interchange

1. Introduction

1.1 General Background

Globalization coupled with development in Information and Communications Technology (ICT) has resulted in emergence of various new information and communication applications. One of these applications is Electronic Data Interchange (EDI) which has facilitated the growth of business to business electronic commerce.

The emergence of ICT has led to the introduction of businesses in electronic form hence the emergence and development of inter-organization systems including EDI. In addition, the development of the Internet and the subsequent realization of its business capabilities further resulted in a new round of technological innovations within inter-organizational systems, ranging from Web forms and extranets to Internet based EDI (Sanchez and Perez, 2003).

There are some misconceptions about what is to be referred to as EDI. For example E-mail is not considered EDI and the reason being that it is used to send information between humans in a form that humans understand, whereas EDI is a computer to computer process (Al-bakri, 2007). Similarly sharing of files through a network such as a Local Area Network (LAN) or Wide Area Network (WAN) is not considered EDI because this does not conform to the definition of EDI.

Value-added networks (VANs) have been the traditional facilitators providing networking connectivity among EDI trading partners (Angeles, Nath and Hendon, 1998). They provide a communications service between EDI trading partners for the electronic transmission of EDI data, catering for the different types of connectivity needed by different businesses. However, the diffusion of EDI has still been very slow mainly due to the high costs of subscribing to VAN services (Smith, 1996). No doubt the current trend in EDI implementation is moving away from traditional networks, Value Added Networks (VANs), to the Internet, because the Internet can provide lower network service charges, larger size of user groups and more available network services (Liang, 2000).

In the articles citing the key benefits of EDI through the Internet, lower cost and interoperable standards, have become increasingly common in practitioner literature (Scheier, 2003), a trend that is also reflected in the academic literature (Johnston et al, 2000). Internet is eliminating the traditional barriers to EDI and the future of EDI as a business solution is now very clear. According to Hsieh and Lin (2004), experts who predict EDI's extinction are near-

sighted, and do not fully understand the true meaning, much less its value. What may be the so called experts mean to say, is that the way EDI is implemented today cannot continue down in the same path and must evolve.

The development of cross-industry standards has also accelerated the rate of EDI adoption over the last ten years (Robson, 1994). The most important development to date has been the creation of EDIFACT (Electronic Data Interchange for Administration, Commerce and Transportation – or trade). These standards, in conjunction with the proliferation of widely-used value-added networks (VANs), have almost completely shifted the risk of technological change from the trading companies, making EDI use more manageable and practical (Handfield et al, 1994).

EDI has multiple definitions. It has been defined as the direct transfer of business information between computer systems in different organization (without human intervention or with minimal human intervention) using widely agreed standards to structure the transaction or message data (Itoh, 2005). Ngai and Gunasekaran (2004) defined EDI as the technology by which business documents (such as orders, invoices, shipping contracts, and so on) are transmitted electronically. Sánchez and Pérez (2003) defined EDI as the electronic transmission of information and documents such as invoices or purchase orders between computer systems in different organizations based on a standard, structure, machine-retrievable format.

The use of EDI has the natural effect of increasing inter organizational co-ordination of activities and of increasing the integration that occurs between supply chain members (Hill and Scudder, 2002). It also provides the technology to enable a range of transactions that could include transfers of funds, demand forecast data, actual point of sale demand data, supplier schedules and customer schedules (O'Callaghan and Turner, 1995). As such, it has provided the means for organizations to connect electronically and the technological infrastructure to support significant re-design of inter-company processes (Lee et al., 2000). EDI also facilitates inter-organizational computer-to-computer exchange of structured information in a standard, machine-readable format.

Consequently, in a study by Molad and Back (1995) on the role of EDI in enabling electronic commerce and information integration, it is shown that a growing number of leading engineering and construction companies from around the world are implementing EDI applications to improve

operational efficiency. With EDI, these companies also benefit from enhanced information quality, and achieve reductions in processing time of project critical information particularly international construction endeavors.

In Kenya there are several initiatives to utilize EDI with a focus on improving organizational competitiveness and amongst them is Kenya Ports Authority (KPA). KPA has implemented an EDI based system under the Kilindini Waterfront Project (KWFP) to automate processes in the port of Mombasa (Kenya: Issues in trade logistics, 2005).

1.2 The Electronic Data Interchange Implementation

The implementation of EDI can be divided into four main phases of action. These are planning, analysis and design, construction and installation, and operations (Kappelman et al, 1996).

Long before EDI implementation, dialogue needs to be established between all parties involved to discern EDI implementation strategies and timelines. Inherent in the discussions for the partners involved is the joint planning and system specification that will facilitate the process of EDI implementation (Smith et al, 1994).

Planning: A project proposal is what is realized from the planning phase. This proposal is required to outline the economic feasibility of the project, proposed changes to business processes and applications. Other areas that should be captured in the planning process include anticipated impacts on business strategies, potential changes in relationships with business trading partners, a preliminary timetable, resource requirements, and an estimate of costs and benefits (both tangible and intangible) for the development and implementation of EDI (Kappelman et al, 1996). A firm decision from preferably the top management is required to proceed to the next phase of analysis and design phase.

Analysis and Design: During analysis, a detailed study is conducted to identify the functional areas within the company which may be affected and to determine the applications which will benefit from EDI integration. After the applications are identified, hardware and software, as well as EDI communications links and support systems are evaluated and selected. User participation in these activities is essential. This not only facilitates needs identification, but also reduces users' frustration and fear of losing control over their operation when EDI is installed (Kappelman et al, 1996).

The design team should review the data to be interchanged and map all data elements to the standard format. All related applications should be EDI-integrated and all pertinent applications and data conversions be mapped out. Other issues, such as security, agreements between partners, back-up, disaster recovery and error recovery should also be addressed.

Construction and Installation: Once an EDI solution has been selected and approved by the EDI steering committee the EDI project then shifts to the construction and installation phase. The team must select EDI software and possibly network providers if VANs are used instead of the Internet. As the system is constructed, auditors should review specifications to make sure existing company controls are maintained. As an electronic system, document storage, archiving and data recovery are vastly different from paper-based systems, the same holds true for the types of audit trails that are available. Auditors must be able to understand and approve the new procedures that EDI requires.

Legal considerations also play a role. This is because EDI transmissions do not contain the customary terms and conventions that proper paper documents contain. Instead, companies sign EDI documents, which specify that existing terms and conditions are in effect for EDI transmissions. Legal counsel should review, draft and approve such agreements.

The greatest construction and installation task is the integration of EDI systems with existing corporate applications (GXS EDI Consulting Inc, 2007). Data required by trading partners and EDI standards must be "mapped" onto data contained in existing systems.

Operation: What happens in operations is that EDI takes control away from single organizations and places it in the hands of many organizations in a supply chain. Because of the crossing of company lines, inter-organizational systems present more operational requirements which do not exist in inter-organizational systems.

Assurance that the Internet or the VAN is capable of operating without interruption and in a proper manner is fundamental. Reliance on other organizations is another feature of inter-organizational systems. Disaster for one organization could mean serious complications for all organizations connected by a single EDI system. A disaster recovery plan is therefore critically important. All organizations in an EDI network must consider the far-reaching effects of a distributed disaster when considering their disaster recovery (Heikkinen and Sarkis, 1996).

1.3 Literature to the Benefits & Challenges of Electronic Data Interchange Implementation and Application

Successful implementation and application of EDI offers numerous benefits. According to Sokol (1995), benefits of EDI include the ability to improve certain business services significantly, increase in productivity and enabling faster and more efficient information exchange with trading partners. Application of EDI also leads to reduced lead-time from placing the order to receiving the goods for manufacturing and retail firms, reduces errors associated with manual documents and data entry, greater sharing of information and greater tracking of market data (Greenstein et al, 2000).

Similarly, Walton and Gupta (1999) pointed out that EDI benefits essentially evolve over stages of EDI development. They analyzed what is involved in the phases from the initial to the final phase. In the initial phase which involves automation, the company has efficiency gains on the individual (company) level. For example, reduced clerical errors and purchase order cost should occur. In the transition from the initial phase to the second phase which involves enhancement, there are still efficiency gains for the individual company, but now the company is focused on the process rather than automation. Reduced inventory levels should result from the improvement in process. In the transition from the second phase to the third phase which involves redefinition, the benefit is in effectiveness gains for the trading partners. Companies should see reduced safety stock levels. Finally, in the third phase the benefit is in strategic gains for the trading partners. This stage is behavior-oriented rather than process-oriented. For example, smaller suppliers should be able to win major contracts because of the EDI capability.

Application of EDI also lowers costs by reducing paperwork and minimizing costs for both coordinating and processing transactions (Murphy and Daley 1999). It also reduces inventory levels and inventory costs by enhancing integration between trading partners' information systems, which allows shorter order cycles and higher inventory turnovers (Droge and Germain 2000). EDI as well reduces transaction-related costs of co-ordination between firms via a standardization of tasks and communication between chain members (Ciborra and Olson 1989), reduces data entry costs and purchase order costs (Sohal et al, 2002).

Application of EDI further maintains efficiency while reducing lead time giving the company the capability to smooth out the peaks and valleys in the normal production cycle (Ali-Ahmadi 2006). Companies too

depend on EDI to streamline their processes in manufacturing, supply chain management, and logistics (DeCovny, 1998), therefore facilitating an effective and efficient supply chain (Crum et al., 1996). The transmission of EDI transactions takes less time than comparable manual transactions such as fax machines, improves accuracy and timeliness of the flow of information (Kekre and Mukhopadhyay, 1992) and therefore enables efficiency improvements (Hammant, 1995). Consequently, fewer items will be lost, returned or required from back order.

Utilization of EDI also enables access to external complementary resources which may be critical to make innovation a successful strategy for a firm (Teece, 1986). Besides these, EDI application enables innovation, because it makes consultations with business partners' mandatory leading to expanded knowledge base hence providing a fertile environment for the much needed innovation. Certainly, firms with strong innovation capabilities are also found to engage in more technical alliances (Gupta et al, 2000). This could be to complement and supplement the firms' innovative resources.

EDI application as well enables timely response. This is because of the speed in which the trading partners receive and incorporate the information into their systems as a result greatly reducing cycle times. For this reason, EDI can be an important component of just-in-time production systems. Firms that apply EDI also benefit from improved information accuracy because it reduces clerical errors (Gottardi and Bolisani, 1996). This is possible because, with EDI there is minimum human intervention in the information flow since it eliminates the need to rekey documents on the destination side.

EDI application also enables standardization of programs and procedures and consequently helps to deliver a product/service that meets consumer expectations with regard to price and time frame, therefore increasing sales as well. Standardization of programs and procedures also allow data to be controlled more easily (Gottardi and Bolisani, 1996). Besides these, EDI provides a varied number of documents which are standardized across industries and within these industries, there are benefits such as lower inventory levels, quick order acknowledgment and efficient invoicing processing. Another benefit of EDI application is that it enhances competitive capacity through a win-win partnership fostered by EDI linkages, such as more timely responses to market changes (Lacovou et al, 1995; Murphy and Daley, 1999). It has also been shown that EDI application enables access to point of sale data and demand visibility between trading partners (Lee and Clark, 1999) ensuring more accurate and streamlined

processes (Casper, 1997) and the ability to “lock in” trading partners through participation in an EDI network (Froehlich et al., 1999).

Likewise, applying EDI in firms also improves trading partner relationship. This is because EDI application enables access to point of sale data and demand visibility between trading partners (Maltz et al, 1997) ensuring more accurate and streamlined processes (Casper, 1997) and the ability to “lock in” trading partners through participation in an EDI network (Froehlich et al., 1999). Similarly, EDI enables the processing of business data up to the last second of deadlines as it is an automated electronic transmission and as EDI compliance is somewhat of a must in modern business environment, once the business is in line, it will reap benefits from this efficient system. Businesses will be able to promote mutual profitability by using EDI, and therefore create enhanced partnership situations.

Similarly, application of EDI promotes environmental friendliness since it eliminates paper work and thus helps to keep the environment clean from waste paper. On the other hand, increased paper demand means an increase in demand of the raw material which is in most cases trees. Consequently, cutting of trees results in environmental dilapidation which may not be suitable for human life. According to the study by the government of Singapore in the elimination of the use of paper invoices and adopting the electronic invoice system, it was found that the process could help to save more than 200 trees a year (Info-communications Development Authority of Singapore, 2009). Reduction in motion of people when EDI is in use as well minimizes air pollution.

Implementation and application of EDI itself is not without its own uncertainties. According to Ngai and Gunasekaran (2004), uncertainties exist because many companies see only factors required for the successful implementation of information technologies while implementing EDI and in doing so they miss several issues that might cause bottlenecks in the implementation of EDI. These issues according to Ngai and Gunasekaran include lack of top management support, lack of motivation, inadequate technical knowledge, under-investment in information technology, lack of confidence, skills and trust. Likewise, Kim and Umanath (1999) pointed out that EDI application achieves data integration but it is not adequate for enterprise and cross enterprise incorporation as it has a number of drawbacks. Besides this, EDI application is unable to provide the flexibility and maintainability demanded by global business with comprehensive IT infrastructures that differentiate them from their competitors (Themistocleous, 2004).

According to the study by Murphy and Daley (1999), small service providers consider critical barrier as high setup costs, incompatibility of hardware/software, lack of standard formats, customer sophistication, and lack of awareness of EDI benefits. Other critical barriers shown by Murphy and Daley include lack of customer education/training, customer resistance to change and corporate culture barrier. In the same study, large business customers identified same critical barriers as small service providers.

In the study by Tuunainen (1998) on small businesses in the automotive industry, key challenges to EDI implementation identified include lack of EDI awareness, confounding standards, too high costs, low transaction volume, technical complexity and data security concerns. Likewise, Philip and Pedersen (1997) studies on EDI implementation and application in Northern Ireland determined major problems. These included difficulties in quantifying the return on EDI investment, high volume of transactions needed to benefit from EDI, high implementation costs, lack of top management commitment, selection of a message standards, impacts on the organization, and legal issues.

Similarly, in the study by Reekers and Smithson (1994), it was determined that the variety of standards and the integration of EDI into the existing system are the most common difficulties for EDI users in Germany and the UK. Besides these, Ramaseshan (1997) found that the most frequently mentioned obstacle in EDI application is top management support, followed by threats to security of information, potential legal problems due to the lack of paper documentation, implementation costs, and technical problems. Angeles and Nath (2000) found that EDI success is most strongly associated with the availability of clear guidelines for EDI transaction agreements, and commitment and sense of ownership of the cross-functional EDI team. Such an environment is uncommon in most business setups.

Various studies done on EDI and other Inter-Organization Systems evidently show that there are various types of barriers to EDI success and which were classified into seven categories. The seven categories are managerial leadership, costs and benefits, technical, human resources management, trading partner relationships, security and legal issues.

Managerial leadership issues relate to strategy. It is the associated changes in operation within and between organizations made possible by EDI link that provide the major strategic advantages of EDI

(Ngai and Gunasekaran, 2004). Similarly, EDI influences the organization's interactions with its trading partners, change business processes, and impact the competitive position of this firm in the industry (Premkumar and Ramamurthy, 1995). All the required changes necessary to support EDI in any situation require support from management. Therefore, all the benefits can only be achieved if the top management has a good understanding of EDI and strongly support its crucial role for its successful implementation and application.

EDI implementation requires substantial financial resources for the system itself, additional hardware and software to enhance communication links, and ongoing expenses during usage (Iacovou, Benbasat and Dexter, 1995). On the other hand, businesses are often concerned with the costs of implementation in comparison to the expected benefits. In today's profit focused market businesses, ICT business solutions have to be cost effective. Therefore, perceived costs and benefits of EDI become a challenge to its implementation and application.

Technical difficulties associated with EDI implementation and applications are common. These include difficulty in integrating existing computer systems with EDI, proliferation of standards, and risk of system instability (Minjoon and Shaohan, 2003). Similarly, full integration of EDI with an organization's internal computer systems and with those of trading partners is considerably a difficult task. This is principally due to the incompatibilities between EDI software and in-house applications, and the existence of several standards for information exchange of protocols, procedures, and data forms (Hendon et al., 1998).

Effectiveness of any technology mainly depends on time and effort to learn and use it. Insufficient education and training for the managers and users can therefore be a grave barrier to EDI success (Banerjee and Golhar, 1994). Similarly, new technology often brings behavioral and organizational changes to an organization. This results in incompatibility of EDI with existing organizational culture, value, and work practices that occur and become one of the greatest barriers to EDI success (Premkumar and Ramamurthy, 1995).

A serious obstacle to EDI success may arise from the difficulty in getting trading partners to use EDI. This could include failure in reaching an agreement on trading terms associated with EDI use (Minjoon and Shaohan, 2003). Other impediment to advanced technologies implementation and innovative management include inaccurate data, existing systems infrastructure and entrenched business

practices (Anderson Consulting, 1994). Extending all these issues across trading partners gets murky.

Security issues, such as the disclosure of messages, modification of message contents, modification of message sequence, sender masquerade, and repudiation of message origin or receipt, are a serious concern for current and future EDI users according to Minjoon and Shaohan (2003). Consequently, when the EDI audit and control procedures fail to detect such security risks, this could severely damage the communication and partnerships between trading partners (Banerjee and Golhar, 1993). Furthermore, the benefits of EDI are uncertain and the technologies of EDI are not so mature enough to make users feel convinced to accept (Chiu and Chen, 2005) and as a result, within an organization and certainly externally, there is a reluctance to share information that often stems from mistrust (Parker, 1997). Consequently for company proprietary information to be unreservedly shared with supply chain partners, trust that this information will not be exploited is required.

According to Minjoon and Shaohan (2003), legal disputes associated with EDI may present potential challenges to business organizations. Consequently, EDI partners together need to clearly make an agreement on all terms and conditions related to EDI use. The terms and conditions of EDI use depends on the partners involved and the nature of business. This may include duration of the contract, designation of who pays for network charges, and the obligations of sender and receiver, in case the document is intercepted by an unauthorized third party or only a part of the document is transmitted (Monczka and Carter, 1988).

The importance of cross-functional teams to both planning and implementation of EDI projects is critical (Carter, 1991 and Sanders, 1992). Likewise, availability of organizational resources specifically time to pursue team assignments, support services, and financial backing is important (Trent and Monczka, 1994). It is also important to have participation and involvement of suppliers in the team, higher levels of internal and external decision-making authority, effective team leadership and higher levels of effort from team members. In other words, a true cross-functional structural orientation requires participative teamwork and cooperation throughout all levels and across functions, an objective that is very difficult to accomplish (Trent and Monczka, 1994). EDI implementation and application is therefore a complex and invasive technology despite associated benefits. This study thus concerns benefits of EDI application and

challenges of EDI implementation and applications with respect to KWFP in Kenya.

1.4 Status of Electronic Data Interchange in Kenya

There are several initiatives in Kenya to utilize EDI with a view to improving organizational competitiveness and amongst them is KPA. KPA has implemented the EDI based system under the KWFP to automate the port of Mombasa (Total Soft Bank, 2007). Other firms applying EDI include major firms in the transport industry mostly in collaboration with their main offices based in developed countries. KRA has also implemented an EDI system and is applied for electronic lodgment of documents by the shipping lines and air lines (Trade Facilitation Project, 2005).

In Kenya, many studies have been done focusing on various aspects of information and communication technology application. This includes “impact and challenges of B2B E-Commerce in Kenya” by Chumo (2003) who found that business to business E-Commerce does create a positive impact to the business performance of the member organization. The study also showed that there were obstacles which need to be ironed out to reap the full benefits of the new technology of doing business. Though business to business e-commerce is an application of information technology in business, it failed to specifically address the benefits of EDI application and challenges of implementation and application in Kenya.

Ndungu (2000) did a survey of “challenges facing Internet growth in Kenya”. She found that the challenges included poor telecommunication infrastructure, lack of information and communication policy, lack of standardized cost structure for internet services, lack of cooperation among Internet Service Providers (ISPs) and high rate of client movement from one client to the other. Although the Internet has facilitated the growth of EDI, the challenges of Internet growth may not be necessarily the challenges of EDI implementation and application.

Odiko (2004) examined e-business as a mode of international business engagement. She noted that although there is much gain in ICT development in Kenya across several sectors, a number of challenges still need to be addressed. Clearly, none of the researchers have explicitly focused on benefits of EDI application and challenges of EDI implementation and application in Kenya.

1.5 The Kilindini Waterfront Project

Before the implementation of KWFP, majority of the processes in the port of Mombasa were not automated (Kenya: Issues in trade logistics, 2005). These processes include the submission of the hard copy vessel bay plans by the shipping agents to KPA, data collection process at the waterfront and other sites, container inventory management and the requirement of the mandatory six copies of the Mombasa Port Release Order (MPRO) thus making the declaration process quite lengthy (Kilindini Waterfront Front Project, 2006).

Information in EDI form is exchanged between KPA and the other stakeholders through the United Nations Electronic Data Interchange for Administration, Commerce and Transport (UN EDIFACT) formats and supplemented by private formats (Kilindini Waterfront Project, 2006). The EDI files exchanged in the shipping industry include BAPLIE for vessel bay plan, MOVINS for vessel pre plan, COARRI for discharge/Loading, CODECO for gate-out container logistic movements, CUSCAR for manifest and APERAK files for message receipt acknowledgement (Garstone, 1995).

Files are transmitted via email from the port users to KPA and the users pick information relevant to them from KPA’s file transfer protocol (ftp) site. Other information is also available to the users through the web interface provided by KPA (Kilindini Waterfront Project, 2006).

Many benefits were expected in the application of EDI in the port of Mombasa. These benefits include minimization of paper documents, cost reduction, more secure processes and automatic, accurate and real-time update on container location leading to faster operational turnaround (Mackay and Rosier, 1996). Other benefits expected in the application of EDI include adequate planning and real-time operation for operational efficiency, increased throughput and reduced cargo dwell time and ship turn around being reduced to a reasonable duration of one day (Kilindini Waterfront Project, 2006). As to whether the benefits were attained is the subject of this study. Also studied are the challenges which may explain the extent of attainment of the benefits.

KWFP is a computerized information system that facilitates the running of the water front and cargo operations in the port of Mombasa (Kilindini Waterfront Project, 2006). It was inaugurated on 10th January 2006 and went live on 1st of July 2008. The project covers Container Terminal Operations, Conventional Cargo Operations, Marine Operations

and the Inland Container Depots in Nairobi and Kisumu (Total Soft Bank, 2007).

The stakeholders in this project are Kenya Ports Authority (KPA) which manages the Port of Mombasa, Kenya Revenue Authority (KRA) under which customs falls and Kenya Bureau of Standards (KEBS) who regulate the standards of the cargo passing through the port (Kenya: Issues in trade logistics, 2005). Other stakeholders include Shipping Lines whose vessels call in the port of Mombasa and Clearing and Forwarding agencies that operate in the port (Kenya: Issues in trade logistics, 2005).

With a vision to be paperless by 2010, KPA introduced a three phased full integration IT strategy (Kilindini Waterfront Project, 2006). This includes application of SAP to automate port administration functions as the phase one, the Kilindini Waterfront Project to implement a planning, operational, and monitoring system that is to bring improved efficiency to waterfront and cargo operations as phase two. Phase three is the Community Based System (CBS) aiming to create a platform where all port users will be able to communicate and share relevant information (Kilindini Waterfront Project, 2006).

The Kilindini Waterfront Automated Terminal Operating System (KWATOS) is the name of the computer system in the Kilindini Waterfront Project tasked with the management of the e-services including EDI (Total Soft Bank, 2007). The main software in KWATOS is the Computer Automated Terminal Operating System (CATOS) illustrated in Figure 1.1. Data is exchanged between KPA and its business partners as indicated in Figure 1.1.

EDI application offers numerous benefits. Benefits of EDI application include lowering costs, providing innovation and enabling timely response. EDI application also aids in decreasing paperwork, improving customer service, improving response, access to information, improved quality through improved record keeping, fewer errors in data entry, reduced processing delays, less reliance on human interpretation of data and minimized unproductive time. Although EDI application offers numerous benefits, there are also many challenges faced in its implementation and application (Bidgoli, 2002). These challenges for EDI implementation include lack of EDI awareness, confounding standards, high implementation costs, lack of top management commitment, selection of EDI message standards, and technical complexity. As for EDI application, the challenges include difficulties in quantifying the return on EDI investment, high volume of transactions needed to benefit from EDI, impacts on the organization, and legal issues associated with EDI application.

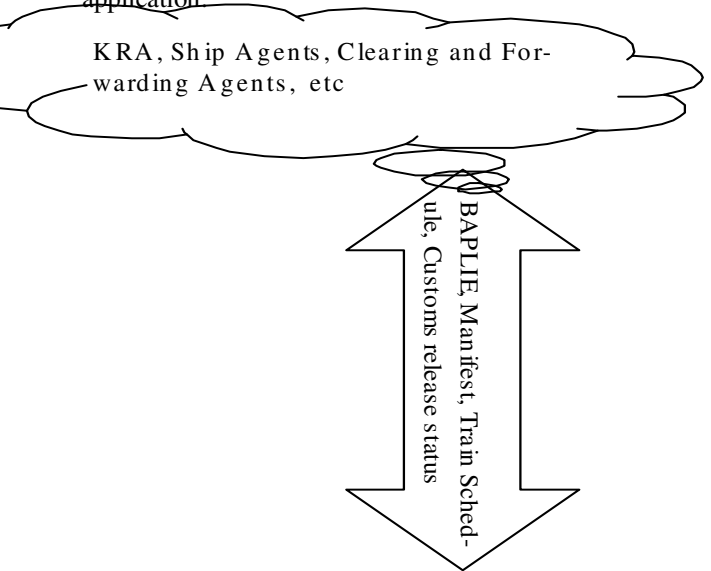
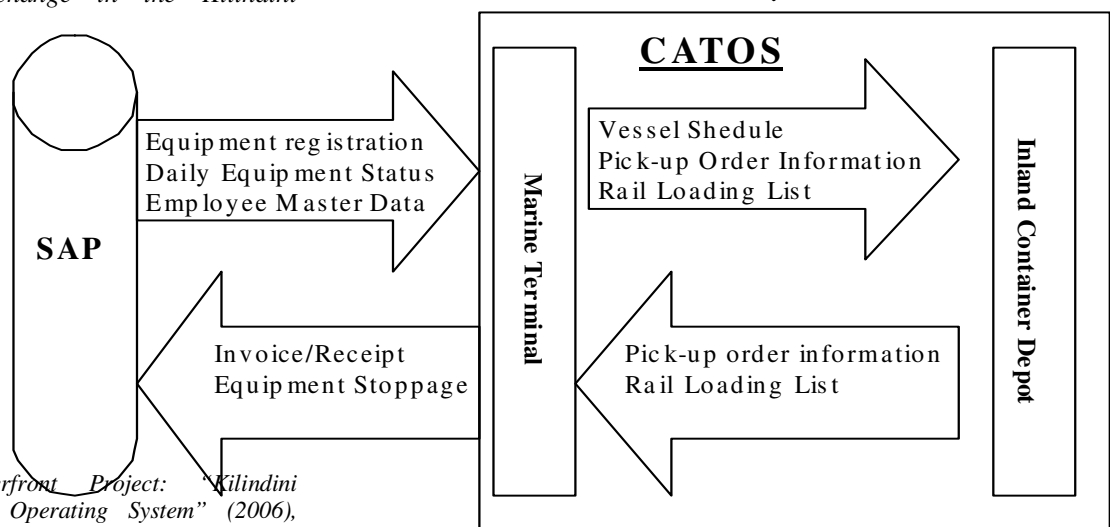


Figure 1.1: Data Exchange in the Kilindini Waterfront Project.



Source: (Kilindini Waterfront Project: "Kilindini Waterfront and Terminal Operating System" (2006), <http://www.kwatos.kpa.co.ke/>).

In Kenya, various studies have been done relating to EDI. This includes the use of Information Technology within libraries in Eastern and Southern Africa by Mutula (2003). His findings showed that there were problems such as poor infrastructure and under-utilization of the technology due to a shortage of skills, shortage of funds to meet the costs of new technology and lack of well-articulated vision or policies by institutions on the deployment of Information Technology.

Similarly, Nyandiere (2002) did a study focusing on challenges facing ERP systems in Kenya. His findings showed the challenges as including cost, complexity of the systems, unreliable vendors, low quality of some of the ERPs, resistance by users, lengthy implementation periods, many organizational changes involved and the customization process required.

Adam (1999) did a research on the impact of information and communication technology in sub-Saharan Africa. It was established that there was under-utilization of the existing technology, inappropriate education, lack of awareness, inappropriate tools and lack of resources. The study also established that there was lack of academically qualified managers, undeveloped legal framework for information sharing, poor connection to global network, maintenance problems, weak research and development, high taxes, over-dependency on donors and poor access to credit.

Kiplang'at (1999) did a research on opportunities for information technology in improving access, transfer and the use of agricultural information in the rural areas of Kenya. The findings showed that for information technology (IT) to have more impact on rural development, it should be needs driven, rather than technology driven and this can only be achieved if the needs of the users are placed at the centre and appropriate technologies adopted.

Even though these studies have been done focusing on various aspects of ICT, none focuses on EDI application and implementation. Consequently, this study aimed to establish the benefits of EDI application and determine the challenges of its implementation and application in Kenya.

2.0 Statement of the Problem

From the literature review, it is clear that EDI is mature and highly effective as an application of ICT. However, the path to a successful implementation and effective application of EDI continue being a

challenge to many cost conscious firms. It is therefore obvious that a broader perspective of research in EDI is required in order to exploit its potential (McCubbery and Gricar, 1995). According to McCubbery and Gricar (1989), developing countries which cannot support EDI, risk losing business to companies located in more highly-developed countries. Kenya being a developing country must therefore intensify its efforts in creating an EDI enabled environment.

It is also evident from the literature review that past research done remains limited regarding this emerging area in Kenya. Consequently, there is a need for further research and contribution in exploring the benefits of EDI application and the challenges of implementation and application. In addressing this gap, there was need for a study to examine the benefits of EDI application and the challenges of its implementation and applications in the KWFP in Kenya.

Growth in EDI capability is becoming a requirement for effectively servicing many large business customers (Furst and Nolle, 1998). Even then, implementation of EDI creates difficult and complex problems for organizations (Ngai and Gunasekaran, 2004). Thus many companies have adopted EDI but have not received the anticipated results (Walton and Gupta, 1999). Consequently EDI benefits are not guaranteed. The application of EDI in business poses many challenges hence it has been mostly limited to large organizations with the resources and a number of potential electronic transactions because of the cost and difficulty of implementation (Power, 2002).

The KWFP was intended to automate the processes at the port of Mombasa in various ways and amongst them is the application of EDI. How would KWFP fare on given the fact that EDI benefits may not be guaranteed. Since EDI benefits are firm dependent then there is expected variation in benefits from firm to firm (Mackay and Rosier, 1996). Therefore what has been found on EDI benefits elsewhere may not be taken to hold for KWFP hence the need for a study that addresses these benefits. Besides this, for the benefits of EDI application to be realized challenges have to be overcome. This makes it necessary to determine these challenges. Evidently there is a need for a research on benefits and challenges of EDI application in the KWFP.

Several scholars and experts have researched on ICT applications in business, E-Commerce, and E-Business. Such studies include investigation of the business value of E-commerce done by Muganda

(2001), E-commerce services in banks in Kenya done by Kiprono (2004) and a survey of challenges facing users of computer based information systems at NHIF by Ojunga (2004). Even though these studies have been done focusing on various aspects of ICT, no studies have examined the benefits and the challenges of application and implementation of EDI in Kenya focusing a large project implementing EDI such as KWFP.

This study therefore concerns EDI application in Kenya with specific reference to KWFP. The study seeks to provide answers to the following research questions: What benefits are derived from the EDI application in the KWP? What challenges are encountered in the EDI implementation and application in KWFP?

The general objective of this research was to investigate EDI application and implementation in Kenya. The specific objectives of the research were to:

- (i) Establish the benefits realized with EDI application in the Kilindini Waterfront Project.
- (ii) Determine challenges of EDI implementation and application at the Kilindini Waterfront Project.

3.0 Research Strategy

This study concerns the benefits of EDI application and the challenges of its implementation and application in the KWFP. A survey research design was chosen in this study since not much has been done in this area. Also, there was no adequate background information relating this research for a more advanced research. The population of interest for the study comprised stakeholders in the Kilindini Waterfront project (See Appendix I). The project involved the Kenya Ports Authority, a number of Shipping Lines operating in the Port of Mombasa, a number of Clearing and Forwarding companies, Kenya Revenue Authority and the Kenya Bureau of Standards. The total number of shipping lines, clearing and forwarding firms operating at the port of Mombasa is over three hundreds.

Convenient sampling was used in this study. This is because of time and financial limitations. Convenient sampling was successfully used by Craft (2000) in her studies on small libraries in Southern California. Likewise, convenient sampling was successfully applied by Ahmed, Ghingold and Zainurin (2007) in their study on Malaysian shopping mall behavior in Kuala Lumpur. In view of this, the data obtained from the selection is still considered good for this

study. A list of the selected firms who are trading partners with KPA and the KPA itself is provided in Appendix I. The number of firms selected was 50. According to Chava and Nachimia (2003), a representative sample should have at least 30 units. In view of this, a sample of size 50 was considered adequate.

Primary data was collected from the selected firms (See Appendix I) with the use of a questionnaire (See Appendix II) addressed to the respondents. The target respondents were IT Managers/Documentation Managers of each of the 50 firms selected because they had the knowledge sought for. The questionnaire was pre-tested on appropriateness, structure and relevance of the questionnaire to the study. Their suggestions were incorporated in to the final version of the questionnaire. The questionnaire was mainly hand delivered to the selected firms' IT Managers/Documentation Managers by the researcher or his assistants and was filled as they wait or picked them later as the situation demanded. In some cases some respondents requested to have the questionnaire on softcopy which was emailed to them.

The questionnaire which was developed with due consideration of the published literature, the researcher's personal experience and discussions with various stakeholders in the industry on the area of the study is attached in Appendix II. The questionnaire is divided in to four sections. Section A of the questionnaire concerned the demographic information about the firms and the respondents. Section B concerned the benefits of EDI application. Section C concerned the challenges of implementing EDI. Section D concerned the challenges of application of EDI.

The data collected in respect of Section A of the questionnaire was analyzed with the use of frequency, tables, proportion, percentages and cross tabulations. This was used to come up with a summary of the characteristics of the responding firms as the characteristics of a firm may have implications on benefits and challenges of EDI application and implementation. The responses in respect of Sections B, C and D were captured on a Likert scale. Further factor analysis was done using the Statistical Package for Social Scientists (SPSS). Factor analysis is used because it uncovers the independent sources of data variations (Rummel, 1970). It was used successfully by Nyandiere (2002) while investigating on the challenges facing ERPs implementation in Kenya. It was also successfully used by Kumpusalo, Virjo and Mattila (2003) in their study on managerial skills of principal physicians assessed by their colleagues in Finland. The data

collected in respect of Sections B, C and D of the questionnaire was also tabulated and analyzed using averages and percentages. Findings were analyzed and presented using tables and charts for ease of interpretation and to show where most responses featured and in the process help make conclusions on the factors focused on the research.

4.0 Data Analysis, Findings and Discussions

A total of 50 questionnaires were distributed targeting KPA, KRA, KEBS, shipping lines and clearing and forwarding firms. A total of 45 out of 50 responses were received. The response rate was therefore 90%. This was considered good for generalization in this study. In a study in implementation of EDI in Hong Kong using a random sample of 1,000, a response rate of 11.7% was obtained and this was considered adequate for the study (Ngai et al, 2004).

The study also captured data on the number of employees in the respondent firms and the size of the firms. From the research data, most firms had less than 50 employees or 51 to 100 employees or 101 to 250 employees, followed by firms with either 251 to 500 employees or 501 to 1,000 employees. The least firms had either 1,001 to 5,000 employees or 5,000 to 10,000 employees. This indicates that most firms have less labor intensive activities and therefore could be relying to some level on automated processes. It may also indicate that most firms are small. From the research data, 68.9% of the firms were wholly foreign owned and no firm was jointly owned. This could be an indication that most of the firms had already some knowledge of EDI since most foreign investors are based in developed countries where EDI use is prevalent.

Data was equally captured in respect of whether or not the firms had undertaken other EDI project prior to KWATOS. From the research data, 73.3% of the firms had undertaken other projects prior to KWATOS and 8.9% were not aware whether their firms had undertaken any EDI projects or not. This indicates that most of the firms that responded had experience in EDI and as such had the knowledge necessary for this study.

4.1 Benefits of EDI Application

The first objective of the study was to establish the benefits of EDI application. From the literature review, the researcher identified 16 variables that could be used to assess the benefits of EDI application in Section B of the questionnaire.

The variables are listed as:

- F1.Reduced paper work
- F2.Reduced errors
- F3.Quick response
- F4.Access to information
- F5.Improved customer service
- F6.Enhanced competitive capacity
- F7.Standardized programs
- F8.Standardized procedures
- F9.Improved cash flow
- F10. Improved trading partner relationship
- F11. Reduced data entry
- F12. Reduced manpower per task
- F13. Improved security
- F14. Reduced inventory cost
- F15. Reduced communication cost
- F16. Reduced legal problemsfor this study.

The variables were included in the questionnaire and the respondents were asked to state the extent they agreed with the statement in a Likert scale of 1 – To a very great extent; 2 – To a great extent; 3 – To a moderate extent; 4 – To a small extent; 5 – To no extent at all. The variables were analyzed using SPSS and factor analysis was done.

Factor analysis is performed by examining the pattern of correlations between observed measures. Measures that are highly correlated (either positively or negatively) are likely to be influenced by the same factors while those that are uncorrelated are likely to be influenced by different factors. Factor analysis done on data on benefits of EDI is discussed below:

The respondents indicated the extent to which each of the 16 variables were a benefit of application of EDI. Since there might have been some group of variables that were similar to each other, factor analysis was used to identify and group such variables together in a correlation matrix.

The correlation matrix gives correlation between all pairs of data sets. In correlation matrix of variables, the existence of clusters of large correlation coefficient between subsets of the variables suggests that the variables could be measuring aspects of the same underlying dimension or factors.

The second SPSS output was the communalities of the variables. Communality is the proportion of variance that each item has in common with other items. The proportion of variance that is unique to each item is then the respective items total variance minus the communality. Communalities are therefore used to supply initial estimates and which can then be either iteratively improved or not. Table 4.1 shows

the communalities of the variables with extraction method being the principal component analysis.

Table 4.1: Communalities- Benefits of EDI Application

	Initial	Extraction
Reduced paper work	1.000	.423
Reduced errors	1.000	.357
Quick response	1.000	.629
Access to information	1.000	.523
Improved customer service	1.000	.579
Enhanced competitive capacity	1.000	.757
Standardized programs	1.000	.720
Standardized procedures	1.000	.585
Improved cash flow	1.000	.865
Improved trading partner relationship	1.000	.762
Reduced data entry	1.000	.622
Reduced manpower per task	1.000	.574
Improved security	1.000	.738
Reduced inventory cost	1.000	.718
Reduced communication cost	1.000	.653
Reduced legal problems	1.000	.752
Extraction Method: Principal Component Analysis.		

Source: Research Data

The third output from SPSS is in table 4.2. The table represents the total original variance of all factors. Principal component analysis was used to extract factors which totaled to 16. Eigen values indicate the relative importance of each factor accounting for a particular set and hence those with a small Eigen values were left out. Only four factors were considered significant for analysis.

Table 4.2: Total Variance Explained- Benefits of EDI Application

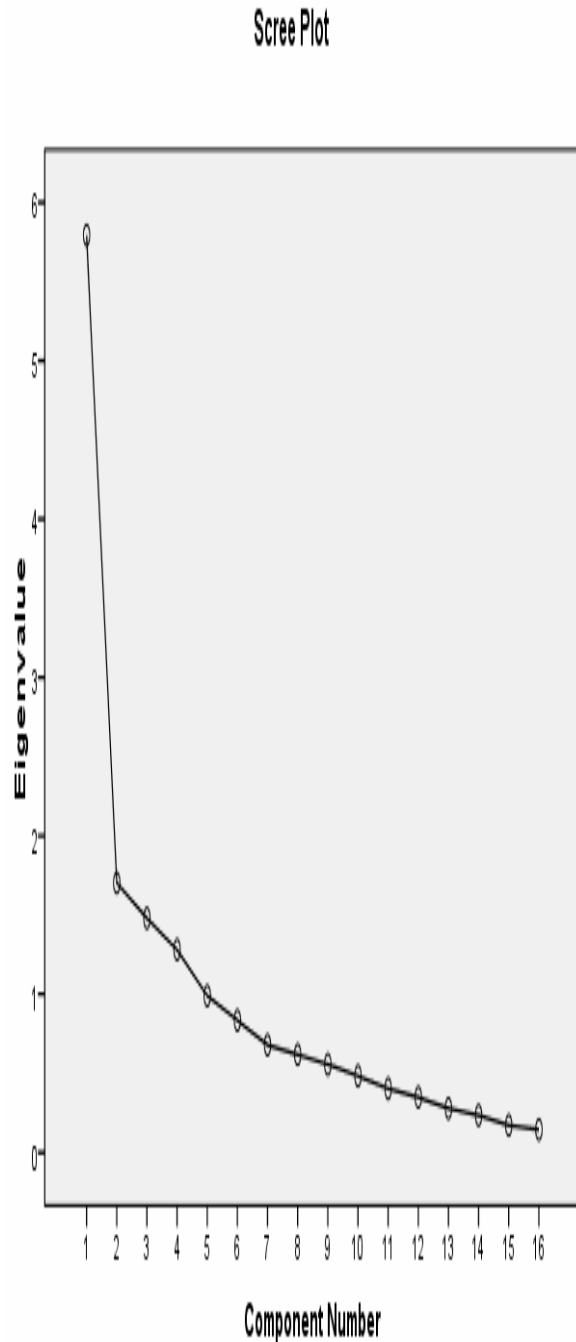
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.794	36.211	36.211	5.794	36.211	36.211
2	1.702	10.641	46.852	1.702	10.641	46.852
3	1.480	9.247	56.099	1.480	9.247	56.099
4	1.280	8.000	64.099	1.280	8.000	64.099
5	.990	6.186	70.285			
6	.835	5.218	75.503			
7	.679	4.245	79.748			
8	.619	3.866	83.615			
9	.557	3.479	87.093			
10	.483	3.020	90.114			
11	.403	2.520	92.634			
12	.349	2.179	94.812			
13	.278	1.740	96.553			
14	.235	1.471	98.023			
15	.171	1.071	99.094			
16	.145	.906	100.000			

Extraction Method: Principal Component Analysis.

Source: Research Data

The fourth output from the SPSS program was the scree plot of the benefits of EDI application. This is a

line segment design of the factor Eigen values plotted against the component numbers. According to the scree plot only four factors are to be considered. This is because the curve tends to flatten from the fourth component onwards, due to relatively low factor Eigen values thereafter.



The fifth output from the SPSS program was Table 4.3. The table shows a component matrix which contains the relative Eigen values in respect of each

factor. Each factor belongs to one of the four sets of factors extracted. It is determined by the Eigen values of the factors relative to each set.

Table 4.3: Component Matrix - Benefits of EDI Application

Component Matrix

	Component			
	1	2	3	4
Reduced paper work	.528	.221		.307
Reduced errors	.541		.229	
Quick response	.718		-.310	-.116
Access to information	.655	-.273	-.119	
Improved customer service	.619	-.380	.154	.168
Enhanced competitive capacity	.454	-.151	.220	.693
Standardized programs	.686	-.479	.129	
Standardized procedures	.701	.200		-.228
Improved cash flow		.668	.642	
Improved trading partner relationship	.792	-.151		-.332
Reduced data entry	.573	.288	.442	.125
Reduced manpower per task	.742		.124	
Improved security	.574	.400	-.499	
Reduced inventory cost	.544	.610	-.178	-.134
Reduced communication cost	.765			-.248
Reduced legal problems	.103	.215	-.562	.616

Source: Research Data

The sixth output from the SPSS program was Table 4.4. This shows the component matrix rotated. Rotation is applied to a component matrix to assist in the interpretation of the factor analysis. A summary of loadings is indicated in the Table 4.5.

Table 4.4: Rotated Component Matrix - Benefits of EDI Application

	Component			
	1	2	3	4
Reduced paper work	.308	.329	.256	.393
Reduced errors	.526	.181	.219	.010
Quick response	.460	.611	-	.113
Access to information	.624	.308	-	.136
Improved customer service	.754	.079	.011	.070
Enhanced competitive capacity	.613	-	.285	.521
Standardized programs	.833	.134	-	-
Standardized procedures	.352	.657	.163	-
Improved cash flow	-	.024	.908	-
Improved trading partner relationship	.602	.594	-	-
Reduced data entry	.402	.268	.622	.042
Reduced manpower per task	.548	.478	.212	-
Improved security	.051	.774	-	.367
Reduced inventory cost	-	.774	.304	.161
Reduced communication cost	.555	.555	.110	-
Reduced legal problems	-	.142	-	.839

Source: Research Data

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.

The seventh output from the SPSS program was Table 4.5. Factor isolation involves separating each of the variable factors. The variable factors are then grouped by the extracted factors based on their factor loadings on each set. Table 4.5 shows the factors grouped.

Table 4.5: Summary of the factor loadings- Benefits of EDI Application

Factor	Variables
1	Reduced errors Access to information Improved customer service Enhanced competitive capacity Standardized programs Improved trading partner relationship Reduced communication cost Reduced manpower per task
2	Quick response Improved security Reduced inventory cost
3	Improved cash flow Reduced data entry
4	Reduced legal problems

Source: Research Data

As shown in Table 4.5, there are four extracted group factors. Extracted group factors 1, 2 and 3 contain the most number of variable components which are the benefits that firms received after applying EDI. Factor 1 is composed of reduced errors, access to information, improved customer service, enhanced competitive capacity, standardized programs, improved trading partner relationship, reduced communication cost and reduced manpower per task. Group factor 2 comprises of quick response, improved trading partner relationship, improved security, reduced communication cost and reduced inventory cost. Group factor 3 comprises improved cash flow and reduced data entry. Group factor 4 has only one benefit that firms relies and that is reduced legal problems.

It is clear that most of the 16 factors listed in the questionnaire were grouped together by their correlation with each other and brought down to a total of four main group factors. The most number of factors elements were in groups 1 to 3 whilst only one fell in group 4.

4.2 Challenges of EDI Implementation

The second objective of the study was to determine the challenges of EDI implementation. From the literature review, the researcher identified 20 variables that could be used to assess the challenges of EDI implementation. The variables are listed as:

- F1. Funding problems
- F2. Inadequate budget
- F3. Lack of top management support
- F4. Negative staff attitude
- F5. Inadequate IT staff training
- F6. Inadequate non IT staff training
- F7. More requirements of changes in business processes than expected
- F8. Change requirement for work practices to fit the system
- F9. Inadequate implementation time
- F10. Difficulties in cooperating with the other partners
- F11. Inadequate feedback from the EDI project managers
- F12. High software costs
- F13. High hardware costs
- F14. High change over costs
- F15. High training costs
- F16. Lack of technical support
- F17. System compatibility problems
- F18. High consultancy fee
- F19. High maintenance costs
- F20. Unforeseen technical problems

The variables were included in the questionnaire and the respondents were asked to state the extent they agreed with the statement in a Likert scale of 1 – To a very great extent; 2 – To a great extent; 3 – To a moderate extent; 4 – To a small extent; 5 – To no extent at all. The variables were analyzed using SPSS and factor analysis was done. Factor analysis done on challenges of EDI implementation is discussed from section below.

Table 4.6 shows the communalities of the variables. The extraction method used is the principal component analysis.

Table 4.6: Communalities - Challenges of EDI Application

	Initial	Extraction
It does not include all business processes	1.000	.774
It is not adequate as an inter-organizational system	1.000	.679

Inadequate budget support	1.000	.758
Lack of top management support	1.000	.790
Inadequate IT staff training	1.000	.789
Inadequate non IT staff training	1.000	.764
Less cooperation from the trading partners	1.000	.761
Data security problems	1.000	.591
Lack of legal framework to handle legal disputes associated with EDI	1.000	.653
Lack of flexibility	1.000	.702
Lack of maintainability	1.000	.579
Lack of awareness of benefits of EDI	1.000	.736
Lack of trust of other EDI partners	1.000	.600

Source: Research Data

4.5.3 Factor Extraction

Table 4.7 represents the total original variance of all factors. Principal component analysis was used to extract factors which totaled to 13. According to the table, only four factors were considered significant for analysis.

Table 4.7: Total Variance Explained - Challenges of EDI Application

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.135	39.502	39.502	5.135	39.502	39.502
2	1.682	12.938	52.440	1.682	12.938	52.440
3	1.256	9.665	62.105	1.256	9.665	62.105

4	1.104	8.489	70.594	1.104	8.489	70.594
5	.792	6.095	76.689			
6	.741	5.697	82.386			
7	.618	4.754	87.140			
8	.506	3.896	91.035			
9	.435	3.348	94.383			
10	.308	2.368	96.751			
11	.180	1.385	98.135			
12	.154	1.186	99.321			
13	.088	.679	100.000			

Source: Research Data

From the generated the scree plot of the challenges of EDI application. We only consider four factors because the curve tends to flatten from the fourth component onwards, due to relatively low factor Eigen values that follow thereafter.

Table 4.8 shows a component matrix which contains the relative Eigen values in respect of each factor. Each factor belongs to one of the four sets of factors extracted, and is determined by the Eigen values of the factors relative to each set.

Table 4.8: Component Matrix - Challenges of EDI Application

	Component			
	1	2	3	4
It does not include all business processes	.240	-.095	.622	.565
It is not adequate as an inter-organizational system	.434	-.559	.118	-.405
Inadequate budget support	.584	-.644	-.040	-.029

Lack of top management support	.673	-.428	.390	-.052
Inadequate IT staff training	.851	.072	.063	.237
Inadequate non IT staff training	.819	.147	.165	.213
Less cooperation from the trading partners	.552	-.024	-.542	.402
Data security problems	.608	-.011	.448	.146
Lack of legal framework to handle legal disputes associated with EDI	.746	.244	-.172	.090
Lack of flexibility	.240	.698	.381	-.108
Lack of maintainability	.649	.334	-.021	-.216
Lack of awareness of benefits of EDI	.795	.047	-.018	-.318
Lack of trust of other EDI partners	.601	.272	.012	-.405

Source: Research Data

Table 4.9 shows the component matrix rotated. A summary of loadings is indicated in Table 4.10.

Table 4.9: Rotated Component Matrix - Challenges of EDI Implementation

	Component			
	1	2	3	4
It does not include all business processes				.876
It is not adequate as an interorganizational system	.137		.810	
Inadequate budget support		.351	.787	.122
Lack of top management support	.259	.104	.727	.429
Inadequate IT staff training	.475	.558	.259	.429
Inadequate non IT staff training	.533	.460	.208	.475

Less cooperation from the trading partners		.870		
Data security problems	.214	.716	.172	
Lack of legal framework to handle legal disputes associated with EDI	.535	.583		.136
Lack of flexibility	.699	-.173	-.348	.250
Lack of maintainability	.699	.280	.112	
Lack of awareness of benefits of EDI	.662	.316	.445	
Lack of trust of other EDI partners	.724	.141	.213	

Source: Research Data

Factor isolation involves isolating each of the variable factors and grouping them by these 4 extracted factors based on their factor loadings on each set. Table 4.10 shows the factors grouped.

Table 4.10: Summary of the factor loadings- Challenges of EDI Application

Factor	Variables
1	Inadequate non IT staff training Lack of trust of other EDI partners Lack of flexibility Lack of maintainability Lack of awareness of benefits of EDI
2	Inadequate IT staff training Lack of legal framework to handle legal disputes associated with EDI Data security problems Less cooperation from the trading partners
3	Lack of top management support Inadequate budget support It is not adequate as an inter-organizational system
4	It does not include all business processes

Source: Research Data

As shown in Table 4.10, there are four extracted group factors. Extracted group factors 1, 2 and 3 contain the most number of variable components which are the challenges the firms faced when applying EDI. Group factor 1 comprises inadequate non IT staff training, lack of trust of other EDI

partners, lack of flexibility, lack of maintainability and lack of awareness of benefits of EDI.

Group factor 2 comprises inadequate IT staff training, lack of legal framework to handle legal disputes associated with EDI, data security problems and less cooperation from the trading partners. The third significant group factor 3 comprises lack of top management support, inadequate budget support and EDI not being adequate as an inter-organizational system. Group factor 4 comprises only EDI not including all business processes.

It is clear that most of the 13 factors listed in the questionnaire were grouped together by their correlation with each other, and brought down to a total of four main group factors. The most number of Factors elements were in groups 1 to 3 whist only one falling in group 4.

5.0 Summary, Conclusions and Recommendations

5.1 Summary

The first objective was to establish the benefits of EDI application. Factor analysis was used to group related benefits. The benefits that were considered by firms to a very great extent were reduced errors, access to information, improved customer service, enhanced competitive capacity, standardized programs and improved trading partner relationship. Quick response, improved trading partner relationship, improved security, reduced communication cost and reduced inventory cost were considered by firms as EDI benefits to a large extent. Improved cash flow and reduced data entry were considered by firms as EDI benefits to a moderate extent. Reduced legal problems were considered by firms as an EDI benefit to a small extent.

The second objective was to determine the challenges faced by firms while implementing EDI. Factor analysis was used to group related challenges. The challenges that were considered by firms to a very great extent were lack of top management support, negative staff attitude, inadequate IT staff training, inadequate non IT staff training, more requirements of changes in business, change requirement for work practices to fit the system, lack of technical support and System compatibility problems. Implementation time, high software costs, high hardware costs, high change over costs and high consultancy fee were considered by firms as challenges to a large extent.

Difficulties in cooperating with the other partners, inadequate feedback from the EDI project, high training costs and high maintenance costs were identified by firms as challenges to a moderate

extent. Funding problems, inadequate budget and unforeseen technical problems were considered by firms as challenges to a small extent.

The last objective was to determine the challenges faced by firms while applying EDI. Factor analysis was used to group similar challenges. The challenges that were considered by firms to a very great extent were inadequate non IT staff training, lack of trust of other EDI partners, lack of flexibility, lack of maintainability and lack of awareness of benefits of EDI. Inadequate IT staff training, lack of legal framework to handle legal disputes associated with EDI, data security problems and less cooperation from the trading partners were considered by firms as challenges to a large extent. Lack of top management support, inadequate budget support and EDI not adequate as an inter-organizational system were considered by firms as challenges to a moderate extent. EDI does not include all business processes were considered by firms as a challenge to a small extent.

5.2 Conclusions

From the literature review in this study, it is evident that EDI application provides many benefits to an organization. EDI Technology however, cannot guarantee the success of a business in all conditions. Therefore, a well planned and executed EDI implementation and application process is necessary for the successful adoption of EDI. The findings from this study also suggest that firms that are applying EDI in Kenya receive benefits from the application. From the factor analysis carried out on variables of the benefits of EDI application, the deduction drawn indicates the benefits as reduced errors, access to information, improved customer service, enhanced competitive capacity, standardized programs and improved trading partner relationship. Other benefits established in the study include quick response, improved security, reduced communication cost and reduced inventory cost.

Despite the benefits of EDI application, this study also shows that there are many challenges encountered in the implementation of EDI. From the factor analysis carried out on the variables of the challenges in the EDI implementation, the deduction drawn indicates the challenges to be lack of top management support, negative staff attitude, inadequate IT staff training and inadequate non IT staff training. Other challenges determined in the study include more requirements of changes in business, change requirement for work practices to fit the system, lack of technical support and System compatibility problems.

This study also shows that there are several challenges encountered in the application of EDI. From the factor analysis carried out on factors of the challenges of EDI application, the deductions drawn indicate the challenges to be inadequate non IT staff training, lack of trust of other EDI partners, lack of flexibility, lack of maintainability and lack of awareness of benefits of EDI. Other challenges to EDI application determined in this study include inadequate IT staff training, lack of legal framework to handle legal disputes associated with EDI, data security problems and less cooperation from the trading partners.

To overcome these challenges, it is essential first to establish dialogue between all parties involved to discern EDI implementation strategies and timelines long before EDI implementation. Inherent in the discussions for the partners involved is the joint planning and system specification that will facilitate the process of EDI implementation and application. It is also vital to provide EDI education and help to the trading partners to increase the number of trading partners and the speed with which trading partners comply. This is because education and training tends to overcome trading partner resistance to EDI and are necessary for the successful implementation and efficient use of the EDI system.

User participation in planning, analysis, design, construction, and installation is also necessary for project success and this includes the users of trading partners. Likewise, encouragement of the constant evaluation, continuous improvement, and ongoing exploration of new opportunities for EDI among all stakeholders is vital. The objectives of this study were therefore accomplished.

5.3 Recommendations for Further Research

This study focused on the shipping industry only. Whether such results would be consistent in other industries or not, would need to be verified through further research. Many factors were also identified as key challenges to EDI implementation and application in this research. It would be useful as a follow up project to assess the impact of each of the factors on EDI implementation and application.

This study also focused on the current status of EDI implementation and application in Kenya. It does not provide any indication of trends of EDI implementation and application. A follow up study to shed more light on current and future expectations on EDI implementation and application in Kenya is necessary.

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Appendix 1: Appendix I: List Of Firms

	Firm	Business
1	Kenya Ports Authority	Port Management
2	Kenya Revenue Authority	Revenue collection
3	Mediterranean Shipping Company Limited	Shipping Line/Agency
4	Mearsk Kenya	Shipping Line/Agency
5	Zim Kenya	Shipping Line/Agency
6	Emirates	Shipping Line/Agency
7	WEC Lines	Shipping Line/Agency
8	Kenya National shipping Line	Shipping Line/Agency
9	PIL	Shipping Line/Agency
10	Diamond Shipping	Shipping Line/Agency
11	Inchape	Shipping Line/Agency
12	Antrak Shipping	Shipping Line/Agency

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13	Seafourth	Shipping Line/Agency
14	Motaku	Shipping Line/Agency
15	Spears	Shipping Line/Agency
16	Sturrock	Shipping Line/Agency
17	Sharaf Shipping Agency	Shipping Line/Agency
18	Delmas Shipping	Shipping Line/Agency
19	Maritime Freight	Clearing and Forwarding
20	Speedex Logistics	Clearing and Forwarding
21	APM Global Logistics	Clearing and Forwarding
22	Mitchell Cotts Freight	Clearing and Forwarding
23	Siginon Freight	Clearing and Forwarding
24	Kenfreight (EA) Ltd	Clearing and Forwarding
25	SDV Transami (K) Ltd	Clearing and Forwarding
26	Interfreight (EA) Ltd	Clearing and

		Forwarding
27	Freight Forwarders	Clearing and Forwarding
28	Spedag	Clearing and Forwarding
29	Jihan Freighters	Clearing and Forwarding
30	Schenker Ltd	Clearing and Forwarding
31	Beachlines Ltd	Clearing and Forwarding
32	Cornerstone Ltd	Clearing and Forwarding
33	Georine Agencies	Clearing and Forwarding
34	Kuehn & Nagel (K) Ltd	Clearing and Forwarding
35	Panel Freighters	Clearing and Forwarding
36	Starfreight Ltd	Clearing and Forwarding
37	Swiftfreight	Clearing and Forwarding
38	Jowaka Superlinks	Clearing and Forwarding
39	DHL	Clearing and Forwarding

		Forwarding
40	Atako Freight Services	Clearing and Forwarding
41	Habo Agencies	Clearing and Forwarding
42	Bahari Forwarders	Clearing and Forwarding
43	Rapid Kate	Clearing and Forwarding
44	Panal Freighters Ltd	Clearing and Forwarding
45	Muranga Forwarders	Clearing and Forwarding
46	Transfreight Logistics Ltd	Clearing and Forwarding
47	Bat Haf Barwil Agencies Ltd	Clearing and Forwarding
48	Bayland Freight Agencies Ltd	Clearing and Forwarding
49	Burhani Forwarders	Clearing and Forwarding
50	Cargo Logistics Services Limited	Clearing and Forwarding

Appendix II: Research Questionnaire

Section A

1. For how long have you worked with the firm? *(Please tick on the appropriate box)*

- Less than 3 Years -----
- 3 Years to 6 Years -----
- More than 6 Years to 9 Years -----
- More than 9 Years to 12 Years -----
- More than 12 Years to 15 Years -----
- More than 15 Years to 18 Years -----
- More than 18 Years -----

Other. Specify

2. How many employees are in the firm? *(Please tick on the appropriate box)*

- More than 25,000 ----- 10,001 to 25,000 -----
- 5,001 to 10,000 ----- 1,001 to 5,000 -----
- 501 to 1,000 ----- 251 to 500 -----
- 101 to 250 ----- 51 to 100 -----
- Less than 50 -----

3. Please indicate the ownership of the company? *(Please tick on the appropriate box)*

- Wholly foreign owned -----
- Wholly locally owned -----
- Jointly owned -----
- Other. Specify -----

4. Prior to the adoption of the Kilindini Waterfront and Terminal Operating System (KWATOS), had the firm undertaken any other project involving Electronic Data Interchange (EDI)? Please explain.

- Yes ----- No ----- Don't Know--

Section B (Benefits of EDI Application)

5. To what extent has the firm experienced the following benefits relating to the EDI application (Check all that apply in a to q)

	Benefits of EDI	To a very great extent	To a great extent	To a moderate extent	To a small extent	To no extent at all
a	Reduced paper work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b	Reduced errors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c	Quick response	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d	Access to information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e	Improved customer service	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f	Enhanced competitive capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g	Standardized programs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h	Standardized procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i	Improved cash flow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j	Improved trading partner relationship	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k	Reduced data entry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l	Reduced manpower per task	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m	Improved security	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n	Reduced inventory cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
o	Reduced communication cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P	Reduced legal problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
q	Other. Specify					

Section C (Challenges of EDI Implementation)

6. To what extent has the firm experienced the following challenges relating to the EDI implementation (Check all that apply in a to t)

Challenges of EDI implementation		To a very great extent	To a great extent	To a moderate extent	To a small extent	To no extent at all
a	Funding problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b	Inadequate budget	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c	Lack of top management support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d	Negative staff attitude	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e	Inadequate IT staff training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f	Inadequate non IT staff training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g	More requirements of changes in business processes than expected	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h	Change requirement for work practices to fit the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i	Inadequate implementation time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j	Difficulties in cooperating with the other partners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k	Inadequate feedback from the EDI project managers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l	High software costs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m	High hardware costs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n	High change over costs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
o	High training costs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
p	Lack of technical support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
q	System compatibility problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
r	High consultancy fee	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
s	High maintenance costs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
t	Unforeseen technical problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
q	Other. Specify					

Section D (Challenges of EDI Application)

7. To what extent has the firm experienced the following challenges relating to the EDI application (Check all that apply in a to m)

	Challenges of EDI application	To a very great extent	To a great extent	To a moderate extent	To a small extent	To no extent at all
a	It does not include all business processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b	It is not adequate as an interorganizational system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c	Inadequate budget support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d	Lack of top management support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e	Inadequate IT staff training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f	Inadequate non IT staff training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g	Less cooperation from the trading partners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h	Data security problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i	Lack of legal framework to handle legal disputes associated with EDI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j	Lack of flexibility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k	Lack of maintainability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l	Lack of awareness of benefits of EDI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m	Lack of trust of other EDI partners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n	Other. Specify					

8. In the process of using EDI by end users what other challenges are experienced?
