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EXTENT OF ADOPTION OF EDI BY SINGAPOREAN SMES: A SURVEY OF PRACTICES

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ABSTRACT

Based on the literature review of EDI adoption and small business use of IT, the four variables of decision factor that influence Singaporean SMEs to adopt EDI were identified as perceived benefit of EDI, organizational readiness for EDI, competitive pressure, and power and inter-organization relationships. Furthermore, EDI volume, diversity, depth, and width were also identified as to the degree of EDI adoption/integration that strongly influences the impact of EDI. Finally, the different levels of impact (transaction benefit, information sharing benefit, and competitive benefit) associated with the different degrees of EDI adoption/integration were also identified. This survey-based research examined these three concepts in Singaporean SMEs. Surprisingly, Singaporean SMEs seldom expected that adoption of EDI would improve their trading partner relationships. However, Singaporean SMEs improved their level of awareness of EDI benefits after adoption of EDI.

Keywords: electronic commerce, information technology, information system, inter-organizational system, electronic data interchange, EDI adoption, small business, small to medium sized enterprises, SME

INTRODUCTION

Information Technology (IT) and Electronic Commerce (EC) have changed and continue to change the way business is conducted around the world [32]. Electronic Data Interchange (EDI) plays a key role in e-commerce and is becoming a necessary way of doing business [26]. The projected advantages of EDI and the growing interest in e-commerce (EC) have produced optimistic forecasts for the rate of EDI adoption [8, 26, 33].

However, Small and Medium Enterprises (SMEs) tend to implement EDI only to satisfy the initiators requirements, increasing the likelihood that an EDI system will be inefficient and thus not provide returns on investment [12]. Furthermore, Lummus and Duclos [20] identified that the use of EDI by SMEs reaped minimal benefits when there is low EDI integration. The lack of EDI capability in small organizations is critical because of the important roles SMEs play in the economy [8, 16].

This research attempts to fill a number of gaps in the literature. Firstly, there is little research on the relationship between the decision factor to adopt EDI, the degree of EDI adoption/integration, and the level of EDI impact. Secondly, there are few empirical research studies on EDI adoption by SMEs (particularly a lack of quantitative research). Finally, it would appear that there has been no research undertaken or published studies on the impacts of EDI on Singaporean SMEs.

Based on the literature review of EDI adoption and small business use of IT, four decision factors that influence Singaporean SMEs to adopt EDI were identified - perceived benefit of EDI, organizational readiness, competitive pressure, and power and inter-organization relationships. Furthermore, EDI volume, diversity, depth and width were also identified as to the degrees of EDI adoption/integration that strongly influence the impact of EDI. Finally, the different levels of EDI impact (transaction benefit, information sharing benefit and competitive benefit) associated with the different degrees of EDI adoption/integration were also identified.

LITERATURE REVIEW

EDI can be defined as the transmission of standard business documents in a standard format between industrial trading partners [34]. It includes traditional Value Added Network (VAN)-based EDI which is conducted by private network and Internet-based EDI which is conducted via Internet using Extensible Markup Language [19]. Cash and Konsynski [5] indicated that EDI has been credited with contributing to enhanced productivity, flexibility and competitiveness, and is often considered a prerequisite for doing business in a competitive environment. Huff et al. [15] identified that EDI precedes modern-day electronic commerce by almost two decades and it is clearly a type of electronic commerce.

E-commerce (EC) in business is the convergence of increasing computing power and declining telecommunications costs; it is revolutionizing transactions as well as radically changing supplier and customer relationships in business [18]. The volume of global e-commerce and the distribution of e-commerce revenues around the world are likely to change remarkably over time. The growth was not uniform around the globe. USA appears to have been an early bloomer in the world of e-commerce with most of its e-potential having already blossomed [6]. Asia as a whole appears less engaged in EC compared to the United States and Europe. One explanation could be that many Asian countries tend to be less developed than Western countries.

A more complete explanation of the lag, however, must include related problems, including lower personal computer penetration, inefficiently managed telecom monopolies, language barriers, hierarchical corporate cultures, and often intrusive and bureaucratic governments [3]. In spite of this inertia, several Asian countries such as Hong Kong, Singapore and Malaysia are in the process of creating IT infrastructure. This will facilitate EC innovation and assist in the removal of the above-mentioned barriers. These countries are aware that the next several years will see tremendous growth in business-to-business EC [18].

However, SMEs globally are perceived as lagging in terms of EC adoption. SMEs tend to implement EDI only to satisfy requirements set by EDI initiators, increasing the likelihood that an EDI system will be inefficient and will not provide returns on investment [12]. Furthermore, an investigation into the use of EDI by SMEs revealed they gained minimal benefits resulting from their low integration of EDI [20]. The lack of EDI capability of small organizations is critical because of the important role SMEs play in the economy [8, 16].

SMEs make a significant contribution to all world economies. In the Organisation for Economic Co-operation and Development (OECD) countries, SMEs are said to represent 95% of all enterprises, accounting for two thirds of employment and being the main source of new job creation [1]. Equally, in developing economies, similar proportions of the business stock are made up of small firms, demonstrating the significant importance of the sector regardless of the level of economic development [1]. Moreover, SMEs can make a positive contribution to the potential of developing economies, and the International Finance Corporation has found a positive correlation between a country's overall level of income and the number of SMEs per 1,000 people [24].

This research focuses on Singapore, which aims to become an 'intelligent island' and an e-commerce hub in the region. A National E-Commerce Master Plan (EC Master Plan) was launched in September 1998 to drive the use of e-commerce [9]. The government has been actively promoting and encouraging SMEs to adopt e-commerce. The Singapore Productivity and Standard Board (PSB) released SME–21 Plan in January 2000 [9]. SME–21 is a 10-year strategic plan aimed at building up the capabilities of SMEs so as to enhance their contributions to Singapore's competitiveness and economic growth [30]. SMEs are an important part of the Singapore economy [30]. There are 120,000 SMEs in Singapore [2], which account for 92 % of total establishments. They employ 51% of the workforce and generate 34% of the total value added [30].

Specifically, this research focused on Singapore SMEs. Contributions of SMEs to the Singapore economy have been well documented in a number of aspects including labor absorption, income generation and distribution, poverty alleviation, training ground for entrepreneurship skills, promoting linkage and providing a complementary role to large enterprises [23]. However, Singaporean SMEs tend to face limitations like shortages of professional and technical manpower, lack of technological expertise, traditional methods of operation,

and lack of economies of scale. Competition in e-commerce is about the fast beating the slow, not the big beating the small. SMEs must recognize the need and urgently embrace e-commerce to stay in the competition [32].

Chong et al. [7] reported that Singaporean SMEs were still in the infant stage of e-Commerce (EC) but they do not explain why SMEs were still at this stage. Most research on EC inhibitors explored EC's usage for all sizes and types of organizations, or investigated issues at a macro multi-country level [25]. Furthermore, these researches have focused on general EC adoption; they have not identified factors that influence EDI adoption in particular. There is very little research investigating EDI adoption by Singaporean SMEs. Focusing this study on EDI adoption by SMEs, is a preliminary attempt to quantify this area.

RESEARCH METHODOLOGY

A total of 445 questionnaires were distributed with pre-paid envelops to the target organizations by the Singapore EDI Committee (SEC). The EDI users were selected from a confidential database of CrimsonLogic, a leading Application Service Provider (ASP) in Asia Pacific. The survey was addressed to the Manager of the IT/IS department within the respondent organization. A total of 94 questionnaires were returned after follow-up phone calls were made followed by re-faxed or re-mailed questionnaires where necessary. Out of 94 responses, 3 cases were deleted because they had too much missing data. Next, assessments were made on the extent and impact of the missing data of the other 91 respondents to determine whether they were due to a random process [11]. As a result, a total of 91 responses were used for the data analysis. The overall response rate was 22.2 percent (91/410).

RESULTS AND DISCUSSION

Decision Factor to Adopt EDI by Singaporean SMEs

Perceived EDI benefit, organizational readiness, competitive pressure, and power and inter-organizational relationships were identified from the literature as major variables of decision factor that greatly influence the adoption and integration of EDI [16-17, 28].

Perceived EDI Benefit Increasing operational efficiency was ranked as the most important benefit firms expected before they adopt EDI. Higher information quality was ranked second and reduced transaction cost was ranked third, with increased ability to compete ranked fourth.

Surprisingly, SMEs seldom expected that adoption of EDI would improve their trading partner relationships. This may be due to the way Singaporean SMEs deal with business. Ho [14] noted that Chinese Singaporean SMEs own 92 percent of all SMEs and that the Chinese culture has an impact on the way they do business. They may still rely on traditional ways to establish trust with their partners and may be unaware that using EDI would improve their trading partner relationship through information sharing.

Organizational Readiness for EDI

Organizational readiness for EDI refers to available levels of financial resources, IS infrastructure, and organizational compatibility for EDI adoption [4, 16-17]. In this survey, EDI readiness includes the financial resources (slack resources indicators) and IT sophistication of the firm.

High Slack Resources Indicators: Before EDI adoption most SMEs (39.6 percent) were at the growth stage, 30.8 percent were at the start up stage and 28.6 percent were at stable/maturity stage. Only 4.4 percent of respondents indicated that new IT discoveries emerged in their industry frequently. Although 63.7 percent of respondents pointed out that the cost of EDI investment was an important issue for their company when considering adoption, 95.6 percent of them felt that management allocated sufficient resources for the EDI system. This may imply that most SMEs are willing to invest in EDI to do business.

From the comparison of company stage before and after adoption of EDI, it would appear that firms have changed their position in terms of the stage of development after adopting EDI. The majority of firms have ranked themselves as stable/mature now.

IT Sophistication: Singaporean SMEs had low IT sophistication before the adoption of EDI. 68.1 percent of them noted that the required IT expertise was an important issue and 65 percent of them thought they didn't have the expertise to acquire the technology when they were first considering EDI. Although 81.3 percent of respondents have integrated computer systems (e.g. accounting/finance, human resource, sales/marketing, etc) and 81.3 percent used e-mail before they adopted EDI, 73.6 percent didn't develop any in-house software and indicated that the sophistication of IT was very low.

To develop the EDI system, almost all of them (98.9 percent) had to acquire new software, 95.6 percent of them had to contract expertise/outside consultants, 27.5 percent of them acquired new hardware, and only 5.5 percent of them employed additional/new IT staff.

Specifically, most of them had to use multiple ways to develop the EDI system, e.g. they had to acquire the new software and contract expertise/outside consultants.

It would appear that almost two thirds (65.9 percent) of SMEs didn't have any professional IT staff before the adoption of EDI. 17.6 percent had 1–2 IT staff, 14.3 percent had 3 – 5 IT staff, and only 2.2 percent had more than 10 IT staff. Closed to two thirds (65.9 percent) of respondents didn't have an IT department before the adoption of EDI. 19.8 percent spent less than S$50 million and only 14.3 percent spent more than S$50 million.

More than half of respondents (62.7 percent) indicated that their IT sophistication was lower than moderate. Only 1.1 percent of them had very high sophistication of computer systems.

Pressure from Competitors Just over one third of respondents (34.1 percent) indicated that their decision to adopt EDI had been influenced by some of their EDI-capable competitors. Furthermore, only 6.6 percent of respondents indicated that they had more than 50 percent EDI-capable competitors before they adopted EDI.

Pressure from Trading Partners Not surprisingly, most respondents (92.3 percent) are non-EDI initiators and 89 percent of them indicated that they faced pressure from their EDI-capable trading partners to adopt EDI. Furthermore, almost half (43.3 percent) faced pressure from government (e.g. customs) and 47.3 percent of them noted that their trading partners requested them to adopt EDI to do business.

Summary of findings from EDI decision factor

- Singaporean SMEs perceived the benefits of EDI in rank order from 1 (most important) to 8 (least important) as: increased operation efficiency (1), higher information quality (2), reduced transaction cost (3), increased ability to compete (4), better customer service (5), improved cash flow (6), reduced inventory level (7), and improved trading partner relationship (8).
- Singaporean SMEs seem to have a relatively low level of EDI organizational readiness especially in IT sophistication where 65.9 percent of them indicated that they didn't have an IT department and IT staff, and 62.7 percent of them indicated that the sophistication of their computer systems were low or very low.
- Two thirds of Singaporean SMEs didn't think that their decision to adopt EDI was influenced by competitor pressure even though they had EDI-capable competitors.
- Singaporean SMEs adopted EDI mainly (89 percent) in response to pressure from their trading partners. The majority of their trading partners were government agencies (43.3 percent) followed by their customers (35.2 percent) and suppliers (7.7 percent).

Few Singaporean SMEs were EDI initiators (7.7 percent) and most of them (47.3 percent) were asked by their EDI-capable trading partners to adopt EDI to do business. EDI initiators are organizations that have recognized the need for EDI, possess the necessary financial resources, have reached a high level of IT sophistication, and have not been pressured by external factors into adopting EDI. EDI initiators are extremely rare in the small firm population because of the relatively large investment necessary for EDI initiation [16]. Hence, the finding that only 7.7 percent of respondents were EDI initiators strongly supports the argument of Iacovou et al. [16].

EDI Adoption/Integration in Singaporean SMEs

In order to evaluate and analyze the extent of EDI usage, four key dimensions of EDI usage are identified. The four dimensions are EDI volume, diversity, depth, and breadth [13, 17, 21, 36].

EDI Volume EDI volume dimension represents the extent to which an organization's document exchanges are handled through EDI connections [17]. It is the estimated percentage of EDI transactions to the total number of business document transactions exchanged over a typical monthly period [13].

More than half the respondents (61.6 percent) exchanged 1 to 50 percent of business documents with their trading partners via EDI. In contrast, only 23.1 percent of them exchanged more than 50 percent of business documents with their trading partners via EDI. Close to half (46.2 percent) of them transacted less than 1 percent of sales and purchases via EDI. It could imply that many firms use EDI for other purposes than to process sales and purchase transactions with their customers and suppliers. This finding is consistent with findings discussed earlier which showed that more than half of respondents (59.3 percent) have EDI links with government (e.g. custom).

EDI Diversity Jun et al. [17] defines diversity as the number of distinct document types that an organization handles via EDI. It is measured by dividing the number of distinct document types an organization handles via EDI,

by the total number of distinct documents that are being employed in an organization [21]. Most respondents (40.7 percent) processed between 26 and 50 percent of business documents via EDI and only 13.2 percent of them processed between 76 percent – 100 percent of business documents via EDI.

EDI Depth According to Jun et al. [17], EDI depth consists of the extent of electronic consolidation that has been established between the businesses processed of trading partners. Jun et al. [17] modified Massetti and Zmud's [21] classification into four levels of depth associated with EDI use, from the shallowest to the deepest: file-to-file, file-to-application, application-to-application, and system-to-system. This classification was used for this research.

Almost three-quarter of respondents (72.5 percent) adopted application-to-application connections. In contrast, only 2.2 percent of firms adopted file-to-file connections. However, the deepest of EDI connection (system-to-system) was still low at 4.4 percent.

EDI Breadth EDI breadth consists of the number of EDI partners with which one firm has established EDI linkages [17].

Obviously, the finding shows that most respondents (74 percent) have established EDI links with less than 6 EDI partners. Only 6.6 percent of them have more than 20 EDI partners. The finding provides evidence that the largest numbers of trading partners they link with were their customers followed by their suppliers. This is because one firm can have many customers and suppliers but there was only one government. The findings indicate that 58 out 91 of respondents had EDI links with the government.

Over three quarters (80.2 percent) of respondents had less than 1 percent of their suppliers using EDI for transactions with their firm and 54.9 percent of them had less than 1 percent of their customers using EDI for transactions with their firm. This is similar to the earlier finding that more than half of firms (59.3 percent) had EDI links with government.

Summary of findings from EDI Adoption/ Integration:

- *EDI volume*: Over 23 percent of Singaporean SMEs exchanged more than 50 percent of their business documents with their trading partners. Many of them used EDI not for sales/purchase purposed but to declare permits with customs.
- *EDI diversity*: Only 13.2 percent of Singaporean SMEs processed more than 76 percent -100 percent of business documents via EDI.
- *EDI depth*: A majority of Singaporean SMEs (72.5 percent) adopted application-to-application connections (third level of EDI depth) but the deepest EDI connection (system-to-system) still had very low usage (4.4 percent).
- *EDI breadth*: A majority of Singaporean SMEs (74 percent) had established EDI links with less than 6 EDI partners and only 6.6 percent of them had more than 20 EDI partners.

In summary, Singaporean SMEs were at a relatively low level of EDI adoption/integration. This finding further supports previous studies that SMEs around the world are still in a relatively immature and unsophisticated usage stage of EDI [16, 22, 27, 29, 31, 36].

Impact of EDI Adoption on Singaporean SMEs

Impact refers to the actual benefits adopters receive from utilizing EDI. The different levels of impact (transaction benefit, information sharing benefit, and competitive benefit) were identified [16].

Close to two thirds (63.7 percent) of respondents thought that their own firms would benefit the most from their EDI systems followed by 30.8 percent of them thought their customers would benefit the most. Only 5 percent of them thought suppliers would benefit the most.

Almost all respondents achieved benefits of improved information quality (97.8 percent) and reduced transaction costs (96.7 percent). However, only 35.2 percent of firms improved their ability to compete. The impacts that firms achieved, in rank order, were: improved information quality, reduced transaction cost, improved operational efficiency, improved customer service, improved trading relationship, increased cash flow, improved ability to compete, and reduced inventory. In the present research, the impact is classified into three levels that is transaction benefit, sharing information benefit, and competitive benefit.

The finding also shows that Singaporean SMEs improved their level of awareness of EDI benefits after adoption of EDI. It may imply that they were willing to integrate EDI more widely and deeply in order to achieve the highest level of EDI impact.

Transaction Benefit In this research study, transaction benefit includes reduced transaction cost, reduced inventory levels, increased cash flow, and improved information quality. More Singaporean SMEs achieved the impact of higher information quality (mean: 2.98) and reduced transaction cost (mean: 2.97). In contrast, fewer achieved the impact of reduced inventory

level (mean: 2.33) and improved cash flow (mean: 2.45). These results may be due to: (1) 59.3 percent of respondents had EDI links with government (e.g. customs) rather than with suppliers and customers. Hence, a majority of them didn't have inventory; and (2) the questionnaire was addressed to the IT/IS managers who may have ignored the indicator of cash flow.

Information Sharing Benefit Information sharing benefit includes improved customer service and trading partner relationship. The impact of improved customer service (mean: 2.68) was higher than improved trading partners relationship (mean: 2.64). This finding may again be because a majority of respondents had EDI links with government. They didn't think that EDI usage could improve the relationship with government.

Competitive Benefit Competitive benefit includes improved operational efficiency and improved ability to compete. The impact of improved operational efficiency (mean: 2.87) was higher than improved ability to compete (mean: 2.35). It may imply that more Singaporean SMEs consider EDI usage a business tool rather than a means to achieve competitive advantage.

Summary of findings from EDI impact

- EDI impact that Singaporean SMEs have achieved, in rank order, were: improved information quality, reduced transaction cost, improved operational efficiency, improved customer service, improved trading relationship, increased cash flow, improved ability to compete, and reduced inventory.
- Singaporean SMEs improved their level of awareness of EDI benefits through EDI adoption.

Analysis of the data to this point appears to provide some insights on the decision factor of Singaporean SMEs to adopt EDI, the degree Singaporean SMEs integrated EDI, and the level of EDI impact Singaporean SMEs achieved. However, it doesn't provide support for the relationships between specific variables of these three concepts. Further analyses are necessary and provided in the following sections.

Correlation Analysis

Correlation analysis was used to identify relationships between specific variables of EDI decision factor, EDI adoption/integration, and EDI impact. Correlations indicate that there are moderate to strong relationships between items proposed to measure a given construct. This suggests that the items exhibit moderate to strong convergent validity [10]. The key findings are discussed below.

EDI Adoption Decision Factor – Degree of EDI Adoption/Integration The results show the significant relationship between key variables of EDI decision factor to the four dimensions of EDI adoption/integration – EDI volume, EDI diversity, EDI depth, and EDI breadth (Tables 1, 2 and 3). The results show that EDI depth was weakly correlated with the variables of decision factor compare to EDI volume, EDI diversity, and EDI breadth.

Another interesting result is that the indicator of pressure from government was negatively correlated to EDI volume, EDI diversity, and EDI breadth but there was no significant relationship to EDI depth (Table 3). This may be explained as (1) a majority of SMEs (59.3 percent) had EDI links with government (e.g. customs) to declare import and/or export permits only leading to low EDI volume, low EDI diversity, and low EDI breadth; but (2) most SMEs (72.5 percent) adopted the third level of EDI communication connection (application-to-application connection) regardless of the decision factor to adopt EDI. Hence, the results from this sample show that higher pressure from government leads to lower EDI adoption/integration degree in terms of EDI volume, EDI diversity, and EDI breadth but not EDI depth.

Table 1: Correlation Analysis – Perceive EDI Benefit associated with EDI Adoption/Integration

		EDI Volume	*EDI diversity*	*EDI Depth*	*EDI Breadth*
Reduced transaction cost	-c -dos	.225* .032	.213* .042	ns	.207* .049
Reduced inventory level	-c -dos	.330** .001	ns	ns	.306** .003
Improved cash flow	-c -dos	.369** .000	ns	ns	.311** .003
Higher information quality	-c -dos	.287* .066	.287** .006	.225* .032	.359** .000
Better customer service	-c -dos	.463** .000	.272* .009	ns	.274** .009
Improved trading partner relationship	-c -dos	.602** .000	.353** .001	ns	.439** .000
Increase operational efficiency		ns	ns	ns	ns
Increased ability to compete	-c -dos	ns	ns	ns	.226* .032

c: coefficient dos: degree of significant ns: not significant ** at 0.01 level * at 0.05 level

Table 2: Correlation Analysis – Organizational Readiness associated with EDI Adoption/Integration

		EDI Volume	*EDI Diversity*	*EDI Depth*	*EDI Breadth*
Stage of company	-c -dos	ns	.228* .029	ns	ns
IT discoveries	-c -dos	.407** .000	.220* .036	ns	.345** .001
Lack of cost of the EDI investment	-c -dos	ns	-.304** .003	ns	ns
Lack of IT expertise	-c -dos	-.236* .025	-.260* .013	ns	-.402** .000
Integration of Computerized system	-c -dos	.380** .000	ns	ns	.413** .000
In-house software	-c -dos	.268* .010	.298** .004	ns	.399** .000
No. of IT staffs	-c -dos	.291** .005	.241* .021	ns	.405** .000
Budget of IT department	-c -dos	.320** .002	.310** .003	ns	.409** .000
Sophistication of computer system	-c -dos	.485** .000	.412** .000	ns	.457** .000

c: coefficient dos: degree of significant ns: not significant ** at the 0.01 level * at 0.05 level

Table 3: Correlation Analysis – External Pressure associated with EDI Adoption/Integration

		EDI Volume	*EDI Diversity*	*EDI Depth*	*EDI Breadth*
Pressure from Competitor		ns	ns	ns	ns
percent of EDI capable competitor	-c -dos	.295** .005	ns	ns	.301** .004
Pressure from Trading Partner		ns	ns	ns	ns
No. of trading partners	-c -dos	.511** .000	.375** .000	.310** .003	.470** .000
No. of large trading partners	-c -dos	.519** .000	.424** .000	ns	.506** .000
percent of sales and purchase	-c -dos	.691** .000	.426** .000	ns	.456** .000
EDI initiative	-c -dos	ns	ns	.245* .019	.281** .007
percent of EDI capable trading partners	-c -dos	.292** .005	ns	ns	ns
Pressure from customers	-c -dos	.227** .031	.353** .001	ns	ns
Pressure from government	-c -dos	-.396** .000	-.302** .004	ns	-.273** .009

c: coefficient dos: degree of significant ns: not significant ** at the 0.01 level * at 0.05 level

Degree of EDI Adoption/Integration – Level of EDI Impact The result shows that significant relationships exist between four dimensions of EDI adoption/integration and all variables of EDI impact except transaction cost (Table 4). The reason is that almost all of them (96.7 percent) achieve this basic benefit regardless of their degree of EDI volume, EDI diversity, EDI depth, and EDI breadth.

Table 4: Correlation Analysis – EDI Adoption/Integration associated with EDI Impact

	Transac-tion Cost	*Inve-ntory Level*	*Cash Flow*	*Information Quality*	*Customer Service*	*T/Partner Relationship*	*Operational Efficiency*	*Ability To Compete*
EDI Volume -c -dos	ns	.414** .000	.297** .004	ns	.441** .000	.583** .000	.418** .000	.556** .000
EDI Diversity -c -dos	ns	ns	ns	.222* .035	.293** .005	.327** .002	.311** .003	.328** .002
EDI Depth -c -dos	ns	ns	ns	.287** .006	.217* .038	.220* .036	.259* .013	.262** .012
EDI Breadth -c -dos	ns	.339** .001	ns	ns	.288** .006	.433** .000	.224* .033	.495** .000

c: coefficient dos: degree of significant ns: not significant ** at the 0.01 level * at 0.05 level

Level of EDI Impact – EDI Decision Factor The results show significant relationships between the variables of EDI impact with the ones of decision factor (Table 5 and Table 6). The variable 'pressure from government' in Table 7 again shows a negative sign. This seems logical, as the low degree of EDI adoption/integration due to higher pressure from government results in low level of EDI impact (Table 3).

Table 5: Correlation Analysis – EDI Impact associated with Perceived EDI Benefit

	Perceived Transact cost	***Perceived Inventory Level***	***Perceived Cash Flow***	***Perceived Inform Quality***	***Perceived Customer Service***	***Perceived T/Partner Relation***	***Perceived Operational Efficiency***	***Perceived Ability to Compete***
Impact of Transaction Cost	ns	ns	ns	ns	ns	ns	ns	ns
Impact of Inventory Level	-c ns -dos	-c .587** .000 -dos	-c .400** .000 -dos	-c ns -dos	-c .255* .015 -dos	-c .249* .017 -dos	-c ns -dos	-c .373** .000 -dos
Impact of Cash Flow	-c ns -dos	-c .268* .010 -dos	-c .293** .005 -dos	-c ns -dos	-c ns -dos	-c ns -dos	-c ns -dos	-c ns -dos
Impact of Inform Quality	-c ns -dos	-c ns -dos	-c ns -dos	-c .220* .036 -dos	-c ns -dos	-c ns -dos	-c ns -dos	-c ns -dos
Impact of Customer Service	-c .316** .002 -dos	-c .238* .023 -dos	-c .213* .043 -dos	-c .214* .043 -dos	-c .369** .000 -dos	-c .344** .001 -dos	-c .321** .002 -dos	-c .271* .010 -dos
Impact of T/Partner Relation -ship	-c ns -dos	-c .387** .000 -dos	-c .428** .000 -dos	-c .331** .001 -dos	-c .380** .000 -dos	-c .587** .000 -dos	-c .284** .000 -dos	-c .300** .004 -dos
Impact of Operation Efficiency	-c .315** .002 -dos	-c ns -dos	-c .303** .004 -dos	-c .393** .000 -dos	-c .220* .036 -dos	-c .343** .001 -dos	-c .219* .037 -dos	-c ns -dos
Impact of Ability to Compete	-c .356** .001 -dos	-c .265* .011 -dos	-c .323** .002 -dos	-c .308** .003 -dos	-c .396** .000 -dos	-c .466** .000 -dos	-c ns -dos	-c .310** .003 -dos

c: coefficient dos: degree of significant ns: not significant ** at the 0.01 level * at 0.05 level

Table 6: Correlation Analysis – EDI Impact associated with Organizational Readiness

	Firm Stage	*IT Dis-covery*	*Lack of IT Expert*	*Nece-ssary Expert*	*System Integ-ration*	*E-Mail*	*In-house Soft-ware*	*IT Staff*	*IT Bud-get*	*IT Sophis-tication*
Impact of Transaction Cost	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Impact of Inventory Level -c -dos	.227* .030	.422** .000	-.373** .000	.334** .001	.246* .020	ns	.376** .000	.361** .000	.373** .000	.321** 002
Impact of Cash Flow -c -dos	ns	.219* .037	-.281** .007	.235* .025	ns	ns	.210* .046	.299** .004	.333** .001	ns
Impact of Inform Quality -c -dos	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Impact of Customer Service -c -dos	ns	.248* .018	ns	ns	ns	.217* .039	ns	ns	ns	.251* .016
Impact of T/Partner Relation-ship -c -dos	.257* .014	.452** .000	-.271** .009	.253* .016	ns	.401** .000	.296* .004	.279** .007	.273** .009	.467** .000
Impact of Operation Efficiency -c -dos	ns	ns	ns	ns	.210* .047	ns	ns	ns	ns	.222* .034
Impact of Ability to Compete -c -dos	ns	.219* .037	-.237* .024	.248* .018	.231* .028	.235* .025	.290* .005	.229* .029	.217** .039	.253* .015

c: coefficient dos: degree of significant ns: not significant ** at the 0.01 level * at 0.05 level

Table 7: Correlation Analysis – EDI Impact associated with External Pressure

	EDI Comp-etitor	*NO. Trading Partner*	*NO. Large T/partner*	*percent Sales/ Purchases*	*EDI Trading Partner*	*Pressure From Customer*	*Pressure From Supplier*	*Pressure From Govern-ment*
Impact of Transaction Cost	ns	ns	ns	ns	ns	ns	ns	ns
Impact of Inventory Level -c -dos	ns	ns	.295** .005	.382** .000	ns	ns	.324** .002	-.381** .000
Impact of Cash Flow -c -dos	ns	ns	.228* .030	ns	ns	ns	ns	-.215* .042
Impact of Information Quality -c -dos	ns	ns	ns	ns	ns	ns	ns	ns
Impact of Customer Service -c -dos	ns	.485** .000	.363** .000	.416** .000	.243* .020	.306** .003	ns	-.309** .003
Impact of T/Partner Relationship -c -dos	.235* .025	.436** .000	.484** .000	.712** .000	.351** .001	.508** .000	.218* .038	-.498** .000
Impact of Operational Efficiency -c -dos	ns	.308** .003	.300** .004	.377** .000	ns	ns	ns	ns
Impact of Ability to Compete -c -dos	.279** .007	.523** .000	.450** .000	.506** .000	.244* .020	ns	.219* .037	-.351** .001

c: coefficient dos: degree of significant ns: not significant ** at the 0.01 level * at 0.05 level

CONCLUSION

The survey research examined the three important concepts (EDI decision factor, EDI adoption/integration, and EDI impact) of EDI adoption process by Singaporean SMEs. The survey results appeared to provide some insights on the decision factor for Singaporean SMEs to adopt EDI, the degree Singaporean SMEs integrated EDI, and the level of EDI impact Singaporean SMEs achieved. The findings indicate that:

(1) few Singaporean SMEs were EDI initiator (7.7 percent) and most of them (43 percent) were asked by their EDI-capable trading partners to adopt EDI to do business,

(2) Singaporean SMEs were at a relatively low level of EDI adoption/integration - this finding supported Iacovou et al. [16] study and Williams et al. [35] study that SMEs are still at an immature and unsophisticated stage of EDI usage, and

(3) the EDI impact Singaporean SMEs have achieved, in rank order, were: improved information quality, reduced transaction cost, improved operational efficiency, improved customer service, improved trading relationship, increased cash flow, improved ability to compete, and reduced inventory.

The conclusion drawn from this research must be considered within the context of the following limitations: (1) the sample size for this study is relatively small; and (2) the sample was chosen from the EDI users of particular system suppliers using non-random purposive sampling. Thus the results may not be able to be generalized to all SMEs which are currently using EDI in Singapore across all industry sectors.

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