

A QUANTITATIVE ANALYSIS OF FACTORS CONTRIBUTING ELECTRONIC DATA INTERCHANGE ADOPTION AMONG BRUNEIAN SMES: A PILOT STUDY

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ABSTRACT

This study investigates fifty small and medium enterprises by using a survey approach to find out the key factors that are determinants to EDI adoption. Based upon the existing model, the study uses six factors grouped into three categories, namely organizational, environmental and technological aspects. The findings indicate that factors such as perceived benefits government support and management support are significant determinants of EDI adoption. The remaining factors like organizational culture, motivation to use EDI and task variety remain insignificant. Based upon the analysis of data, recommendations are made.

Keywords: *small and medium enterprises, electronic data interchange, IT adoption*

1. INTRODUCTION

During the last decade of the twentieth century, businesses around the world have witnessed immaculate benefits from the Internet based business or electronic commerce (EC). The success of EC in the large businesses has shifted focus toward the small business enterprises (SMEs). Researchers and practitioners of EC view electronic data interchange (EDI) as a new venue of improved services and potential benefits as an early foundation block of EC [1]. However, a number of studies [2]-[3] have suggested that small businesses have shown a great interest in EDI.

EDI is a subset of an inter-organizational system (IOS) providing a structured form of communication. IOS has become a very popular vehicle for electronic transfer of information in sales invoices, purchase orders, shipping, billing and other tasks from one firm to another. EDI is a tool that can be used to slash inventory, improve cash flow, and streamline a company's operation [4]. EDI in fact emerged in late 1960s when transportation companies were looking for ways to alleviate delivery delays that resulted from large volumes of paper documentation [5]. The use of EDI however became popular and widespread in late 1980s and early 1990s. Currently, many large organizations in US, Canada, and Europe are using EDI to support their trading activities. The adoption of EDI has also progressed rapidly in Australia [6].

In the past considerable research on EDI was conducted for large business; whereas, studies on Small and Medium Enterprises (SMEs) towards the adoption of technology is a recent phenomenon. However, majority of these studies were confined to the USA, Canada and Europe. Comparatively less has been researched in the Asia-Pacific and the numbers of studies on EDI adoption in South-East Asia remain marginal. Unfortunately, not a single empirical study on EDI

adoption was undertaken in Brunei Darussalam (henceforth referred to simply as Brunei), a small equatorial island of South-East Asia situated in between Singapore and Malaysia. However, in the past some studies were conducted reflecting the use of IT in general, among the SMEs [7] and adoption of EC in Bruneian SMEs [8].

2. LITERATURE REVIEW

An overwhelming portion of past empirical studies had focused on EDI use in context to large organizations, and little efforts have so far been expended to understand how EDI is actually being used by small organizations - which lack information systems (IS) sophistication. A dominant portion of past EDI empirical literature had concentrated on EDI adoption in large organizations. The work of Massetti and Zmud [9] fall in this group.

A review of IS literature indicates that most of the empirical studies on EDI had attempted to identify a set of factors that help researchers distinguish between EDI adopters from non-adopters. These factors were drawn from diverse disciplines including organizational behavior, IT diffusion, economics, and information systems. The commonly reported factors were compiled, and are grouped into three broad categories: organizational, environmental and innovation. However, no established pattern of results had emerged from these studies due to contradictory findings reported by the researchers.

Kuan and Chau [11] in survey of 575 small firms in Hong Kong found factors like perceived direct benefits are considered higher by adopters than non-adopters and perceived lower cost, higher technical competence and higher government pressure rather than industry pressure remain significant. Chau and Jim [12] in another study of 644 Hong Kong SMEs conclude that perceived direct benefits, perceived cost, IT knowledge, trading partner's influence and government incentive are significant factors for EDI adoption.

In summary, the EDI adoption has been studied within the context of SMEs using several approaches and operationalizations. From the review of the existing literature it is evident that there are number of overlapping divergent models that have been shown to potentially explain the EDI adoption decision by examining different factors. Most of the studies have addressed three factors influencing the EDI adoption or intent to adopt EDI within small business context. These are: organizational, technological and environmental. These factors within their domain have added to the existing knowledge. However, most of the studies on EDI are based on case study method that is a good way of developing hypothesis but unfortunately this method makes it difficult to generalize the results to a large population. So there is a need of conducting more empirical studies to provide statistical validity and generalizability. Researchers across the globe selected different factors that might not be suitable to Asian context.

3. DEVELOPMENT OF HYPOTHESES

On the basis of existing literature and previous Brunei based studies [7], [8], [13] and [14] on the usage of technology, a one stage normative model was developed which provides the basis of research objectives. This normative model, is a one-stage model that relates the independent and dependent variables without any intervening variables. The relationship as shown in the model is associative rather than causal in nature. In this study, adoption of EC is the dependent variable and there are eight independent variables grouped into three categories. Detailed justification for the inclusion of each independent variable in the model is prescribed below.

3.1 ORGANIZATIONAL FACTORS

In the last twenty years, Hofstede's [15] theory of the specific patterns in the values and beliefs that constitute culture has gained significant prominence. One of the most important aspects of Hofstede's work is that he successfully linked his dimension of culture to management practice. Hofstede describes the central concept of an organizational culture as having a coherent set of beliefs with a set of shared core values.

It has been shown by the researchers Scheien, [16] and Hussain, [17] that organization culture affects the way an organization behaves, its values and its basic underlying assumption to technology diffusion. It is evident that culture of an organization either facilitate or impede the process of technology diffusion. Viega *et al.* [18] and Ciganek *et al.* [19] have discussed the role of the culture in Technology Acceptance Model (TAM) of Davis [20] and in context of TAM with knowledge management system and concluded that cultural induced beliefs influence the core variable of the TAM.

However, Harris, [21] studied this variable while looking at the attitudes of end-users but could not find the support of organizational culture with the attitudes of the end-users. However, the relevant importance of this variable in the inter-organizational decision-making has led us to include this to study EDI adoption within different geographical and technological environments. The items measuring the organizational culture include; both from power distance and perceived autonomy constructs and is adapted after Tayeb [22].

Organization structure is becoming more and more complex and with this complexity the focus was shifted to include factors that directly influence the adoption of technology within an organizational context. Among them the top management support is very commonly studied factor in the IS research. It is further advocated that success of IT within an organization can be determined by considering management commitment to the IT by allocating necessary resources [23]. Thong & Yap [24], [25] have investigated Top Managers and CEO parameters in their studies and found the importance of this variable. Fink [26] concluded that top management factor could be important for the success of information systems within organizations. Moreover, Tan and Teo [27] have measured the management support and found it a significant predictor of the Internet adoption.

Motivation theorists often distinguish between two broad classes of motivation to perform an activity: Extrinsic motivation and intrinsic motivation [28]. Extrinsic motivation refers to the performance of an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself such as improved job performance and business gains. Whereas Davis *et al.* [29] in their two studies found usefulness and enjoyment (both extrinsic and intrinsic motivation) to mediate fully the effect on the usage intention of perceived output quality and found the importance of both extrinsic and intrinsic motivation to use computers in the workplace. On the other hand, Venkatesh, [30] in his research studied the role of intrinsic motivations as a lever to create favorable user perception

Based upon these, we therefore propose the following three hypotheses:

H1: Organizational culture is positively associated with likelihood of EDI adoption.

H2: Management support is positively associated with likelihood of EDI adoption

H3: Motivation to use is positively associated with likelihood of EDI adoption

3.2 ENVIRONMENTAL FACTOR

The impacts of governmental policies and initiatives have been shown to have direct and indirect stimulation to the supply of information that produces faster technology. For many organizations, government has been a source of funding infrastructure [31]. This study investigates government's involvement and support in EDI adoption in SMEs. By establishing a governmental body, Brunei Information Technology (BIT) Council under Ministry of Communications, His Majesty's Government has further shown its commitment in providing a legitimate and positive leadership role in developing an infrastructure to digitize its economy.

Several researchers in the recent years have studied the governmental role. Ang and Pavri [23] found direct intervention of the government could be considered as important in promoting technological innovation although the degree of influence on firms may vary between countries. Seah and Fjermestad [32] emphasized that both government and private sector play a vital role in supporting the pillars of EDI framework.

An understanding of the roles of government as facilitator for EDI would flourish and mature the strategic framework for EC. Yap *et al.* [33] examined the impact of government incentive program on IT in forty small businesses. Evidence has shown that governmental incentive in the form of economic, financial and technological support had lowered the barrier of IT adoption. Goh [34] suggested that government could play a leadership role in the diffusion of innovation. Tan and Teo [27] and Teo and Tan [35] have discussed the governmental role and support for the Internet adoption studies.

Governmental support is measured in the present study by construct used by Tan and Teo [27] for their Singapore-based study. Based upon this we therefore propose the following hypotheses:

H4: Governmental support is positively associated with EDI adoption.

3.3 TECHNOLOGICAL FACTORS

Adoption of IOS is largely based on perceived benefits which is one of the key reason why organizations adopt and continued using the Internet technology. Perceived benefits are defined by set of anticipated advantages that innovation can provide the organization. These benefits can be direct or indirect as mentioned by Chwelos *et al.* [10]. Direct benefits include operational cost saving and improved organizational functioning. On the other hand, indirect benefits are opportunities that are the outcome of the use of innovation such as improved customer services. Moore and Benbasat [36] study have concluded that compatibility of the innovation with the existing set of values and perceived benefits were the most influential determinants of the technology usage.

Task variety provides an additional dimension to the rapid adoption of an innovation. Task variety refers to the extent of diversity across the task within a single role. Goodhue and Thompson [37] emphasized the importance of fit between use of technologies and users task in achieving individual performance impact. Information technologies are characterized by flexibility and choice of tools [38], therefore innovation would be more applicable and accepted where a variety of task were performed. Harris [21] has studied task variety in his study of end-users' attitudes and found a support of this variable. Task Variety is measured in the present study by the construct used in online EC survey [39]. Based upon these, we propose the following two hypotheses:

H5: Perceived Benefits are positively associated with EDI adoption.

H6: Task variety is positively associated with EDI adoption.

4. METHODOLOGY

4.1 Design of Instrument

From the review of literature, an instrument was developed with the aim of covering the basic research objectives. The questionnaire was divided into four parts. Part A captured the data about the demographic profile covering organizational characteristics, such as, nature, type, size and revenue of business and managerial profile such as age, gender, ownership of PC, and their educational level. Part B covers the information about management support activities about EDI.

Part C of the instrument-included items that measure the perceived benefits. The items are adapted after Chwelos *et al.* [10]. Part D of the instrument measures the organizational culture. We have used the construct to find an extent organizational culture brings in SMEs to determine EDI adoption.

One of the objectives of this study is to find the factors predicting EDI adoption within SMEs. Multi-dimensional, multi-items constructs were used to capture the information about various types of tasks accomplished to adopt EDI. Multi-items construct in Part E of the instrument were adapted after online survey instrument (SRI).

To assess governmental support, a construct was used to measure three main support items. The items were adapted after Tan and Teo [27] for their Internet based study in Singapore. Finally, to assess extrinsic motivation, a construct was used with eight items but factor analysis has reduced it to five factors and was adapted after Teo *et al.* [35]. The items were reworded to cater for this study as the original items were used in different context.

4.2 Instrument reliability and validity

Several techniques were used to assess the reliability Cronbach's coefficient (α) [40] and to assess face, construct and convergent validity. In order to ascertain face validity, an initial questionnaire was passed through the routine editing after it was given to the panel of experts (academics, practitioners and business managers). They were asked to respond to the questionnaire and based upon their comments; questionnaire was reworded to enhance the clarity.

In general, validity refers to the degree to which instrument truly measure the constructs that are intended to measure. There are several types of validity measures that include the face validity and constructs validity. Campbell and Fiske [41] proposed two types of validity: convergent and discriminating validity. Convergent validity is measured by average variance extracted for each construct during the reliability analysis that should be 0.5 or 50% or better [42].

To further analyze for convergent and discriminating validity of these six constructs, principal component method with varimax rotation was used to assess the variance explained. In general results show that both validities are satisfied. The results are not included due to space limitations.

4.3 Data collection

A questionnaire was sent to 100 SMEs according to stratified random sampling plan. Out of these fifty-three organizations responded, where as, responses from three organizations were dropped, as their managers did not fill it. So the samples of fifty organizations were retained for further interpretations. This makes the response rate of 50%, sufficient enough to make logical conclusions.

5. FINDINGS & ANALYSIS

Fifty questionnaires received were analyzed using SPSS version 11 for descriptive analysis, correlation and multiple regression analysis to predict EDI adoption. The data showed that about 42% of the businesses are sole proprietors, 14% are partnership based, 22% are small corporations and 22% are limited companies.

The respondents were asked to assess their current level of EDI adoption (dependent variable) on five point Likert scale; 1- not at all adopted to 5-for fully adopted. 67% percentages of the respondents have mentioned below average use of EC. 27% has mentioned the average EDI usage and about 6% of respondents have mentioned above average to full EDI adoption. The mean EDI adoption remains as 2.58.

In line with the principles of multivariate data analysis, we conducted a zero-order correlation between the independent and dependent variables. The correlation provides directional support for the predicted relationship and shows that colinearity among the independent variables is sufficiently low so as not to affect the stability of regression analysis [43]. Perceived benefits, management support and government support are significantly correlated with EDI adoption. It is apparent that none of the variables are highly inter-correlated, so the problem of multicollinearity does not exist thus fulfilling Hair *et al.* [43] criterion that says that variables to qualify for multicollinearity should have a coefficient of correlation 0.80 or higher.

Prior to the regression analysis data were screened for outliers and cases with standard deviation greater than 2 and cases with missing values were removed. The result of a stepwise regression analysis that confirmed the above result. The data further concluded that three of six independent variables are significantly contributing toward regression equation. The effect of multicollinearity was studied by examining the VIF values for each of the regression coefficients. It was found that values for all the coefficients were less than 10 and as such multi-collinearity was not a problem to distort the regression analysis.

The model has high and significant F ratio indicating good fit of the model and statistically significant in explaining the adoption of EDI by SMEs. The Beta's (standardized coefficient) indicate the relative importance of the independent variables in explaining the adoption of EDI by the SMEs. Durbin Watson test for autocorrelation indicated the absence of correlated residuals. Moreover, 53% of the variance is shared by the three independent variables indicating that model is effective in predicting adoption. Thus in their final analysis hypotheses H2, H4, and H5 are supported.

6. DISCUSSION OF RESULTS

One of the objectives of this study was to identify the EDI adoption within Bruneian SMEs. On a five point Likert scale the mean adoption is 2.58 does not show an attractive picture of EDI adoption among SMEs but indicate a consistency among the similar research in developing countries of Asia and Asia-Pacific. As mentioned previously, 67% of the surveyed organizations have adopted to some kind of EDI. It has further revealed that there is significant difference of business use of the Internet among SMEs ($p < 0.05$). 89% of the businesses have the Internet account but it is mainly using for E-mailing. Homepage is available to 52% of the organizations. 51% of the organizations either have in-house Web server or provided with the vendor support.

Organizational culture is not found to be important factor in determining EDI adoption. This is a true as most of the SMEs lack proper organizational structure due to the strong owners'/managers' influence on the business. The findings do not only provide empirical support to the previous findings of Terpsta and David [44] and Hussain [17] but also provide the argument against the influence of organizational culture on EDI adoption. However, the results of this study are in line with Harris [21] and Seyal *et al.* [8]. This might be due to the reason that few organizations had adopted EDI as an early adopter and the chance is that organizational culture could not be very viable factor at the early stage.

The second organizational factor, management support toward EDI adoption was found to be significant. This suggests that management support in these SMEs does have a prominent effect on EDI adoption. This might be due to the fact that strong management influence of these surveyed SMEs has contributed to the adoption decision directly. The result is in line with the findings of Ang & Pavri [23], Thong and Yap [24], [25], Seyal *et al.* [13] and Tan and Teo [27]. The respondents admitted that that management has a good understanding of the strategic importance of EDI but when the question came regarding deployment of the resources for the past two years, about half of the responses were negative. This again supports the premise that due to limited financial and other resources, management could not deploy the desired funds to reap full benefits of EDI innovation.

The third organizational factor extrinsic motivation to adopt EDI that was introduced first time for the study could not be supported and remained as insignificant. The findings are in contrast with Davis *et al.* (1992) and Teo *et al.* [35]. Previous researchers have studied the relative importance of government support augmenting with the SMEs decision of technology adoption. Because of its importance, it is included in this study. Government incentive and support were found to be significant and influencing EDI adoption. The greater government incentives as perceived by an organization the higher is the likelihood of an organization to adopt EDI. It is mainly due to the governmental dynamic policies to develop and promote the EDI within SMEs. Our findings support the prior studies by Yap *et al.* (1994); Tan and Teo [27], and Teo and Tan [35]. Findings are further in contrast with Seyal *et al.* [14].

Perceived benefits are found to be important predictor for SMEs. The plausible reason for the relevant importance of this variable in SMEs is due to the better management structure and policies. The management of these SMEs considered the perceived benefits as an important prerequisite to decide on technology adoption. If the benefits are not viable they might not decide on the technology. This might be due to the fact that decision-making process in SMEs is always short term [26]. The organizations may pay more attention to the viable benefits. Perceived benefits can act as motivators to encourage the adoption of an innovation because direct benefits are more viable and are easier to measure. So this study supports the prior studies of Moore and Benbasat [36] and Chwelos *et al.* [10] that perceived benefits were the most influential determinants of the technology usage. In his study of EC adoption among Bruneian SMEs, Seyal and Rahman (2003) found the relative advantage as a one of the significant factors of adoption.

Task variety was measured by asking the respondents' seven questions on Likert scale that how the respondents rate to perform various tasks of using the Internet business techniques. For the task variety, both small and medium firms are having the considerably higher mean values (small = 3.23, and medium = 4.06). Further t-test statistics has revealed no statistical difference ($t = -1.90$, $p > .05$) between small and medium sized firms. The one item measuring "use of Web site for market research to find new products and service ideas" has over all higher mean for SMEs. The study however does not supports the previous findings of Gani [38], Goodhue and Thompson [37] and Harris [21].

CONCLUSION

This preliminary study was based upon a survey of 50 SMEs examining EDI adoption in Brunei. The study identified various factors predicting EDI adoption within surveyed organizations. The findings support similar other regional Asia-Pacific studies and increased the generalizability of the previous researches.

At the outset, the EC adoption was measured on five point Likert scale. The mean EDI adoption was measured as 2.58 with 6% of the organizations have adopted EDI to average to somewhat above average EDI activities. This further concludes that 89% of the organizations that have the Internet account are using mainly for the e-mailing purpose to simply enquiring or answering customers, vendors or suppliers. It is obvious that some of these responding organizations have actually misinterpreted the term EDI.

Out of three organizational factors studied only management support was significant predictor of EDI adoption within SMEs. Under environmental factor, we studied the government support which was found significant in determining the EDI adoption among SMEs. Out of other factors studied technological factors; perceived benefits were only significant predictors that affected Bruneian SMEs. These SMEs are rapidly adopting EDI if they are provided with benefits that could be accomplished through EDI.

Although management support, government support and perceived benefits are important predictors of EDI adoption yet perceived benefits have the highest beta coefficient obtained through regression analysis further emphasizes on the relative importance of the variables over the other two. This further indicates that management of the SMEs must focus on the overall EDI benefits compared with the other organizational and environmental factors to gear up the adoption process. Based upon the results and conclusion of the study, we propose that in order to get the full potential benefits from EDI adoption, these SMEs must adopt a pro-active approach and focus more on the potential benefits that can be reaped from EDI.

As such this is a first study of its kind; it has its own limitations. The small sample is the major hindrance in generalizing the results to the entire SMEs; however the study has provided a base for further investigation and need to be addressed in the forthcoming studies. Secondly, around half of the percentages of EDI adoption variance remain unexplained. It further suggests that future work should focus on more variables.

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