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An Exploratory Examination of the Relationship between Business to Business Electronic Commerce Adoption and Competitive Advantage of Small and Medium-sized Enterprises

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ABSTRACT
Business to Business Electronic Commerce (B2B EC) adoption has been growing at a quicker pace in recent times and it has become one of the critical ways to help small and medium-sized enterprises to gain and sustain competitive advantage. A firm's resource capabilities and endowments influence the different levels of B2B EC adoption that leads to competitive advantage gain and sustained in proportion to that level of adoption. The purpose of this research is to offer an exploratory analysis into the relationship between B2B EC adoption and competitive advantage. A survey of 315 responses was received from managers and owners of manufacturing SMEs in Ghana. A canonical correlation analysis is used to explore this relationship. The results support the view that there is a positive relationship between B2B EC adoption levels and competitive advantage.

Keywords: B2B EC adoption; competitive advantage; SMEs; Canonical correlation analysis; Ghana

INTRODUCTION

Today's rapidly changing global economy has forced many business organizations to reconsider how they take advantage of information technology (IT) capabilities to gain competitive advantage. There is increasing inter-dependence among national economies through global trade, and this has advanced the path of economic development worldwide. For a business to survive in the fierce global competition and digital age, there is the need for organizations to re-assess their enterprise business model in order to gain business efficiencies (Marinagi, Trivellas, & Sakas, 2014). Information sharing across suppliers, business partners, and customers is facilitated through IT practices and techniques, by integrating both internal and external business functions. B2B EC provides the means to link technology and people, through information sharing to facilitate supplier-customer interactions and cost minimization (Ghobakhloo, Arias-Aranda, & Benitez-Amado, 2011).

For example, studies has shown that organizations have used the information technology, including B2B EC to enhance their competitive advantage in areas such as information distribution and marketing, sales and product distribution, research and development, and customer/supplier and product support services (Hamad, Elbeltagi, & El-Gohary, 2018; Teo & Pian, 2003).

Researchers have widely acknowledged that B2B EC promotes the growth of businesses, mainly, small and medium ones in the developed nations through the use of the internet and communication technologies (Ifinedo, 2012; Molla & Licker, 2005). SMEs are regarded as very crucial to the growth and innovation of both national and international economies as they help to diversify their economies. The growth of B2B

EC provides a unique opportunity to global markets for SMEs in both developed and developing countries. This fact does not only measured the number of SMEs which characterized almost 90% of the total establishments across the globe, but also their significant role as the engine of growth and prolific job creators (Ayyagari, Demirguc-Kunt, & Maksimovic, 2011; Wit & Kok, 2014). The technological revolution and the internet has become an integral part of SME business operations in developing nations (Aminu, 2013; Jahanshahi, Zhang, & Brem, 2013). B2B EC can assist SMEs to advance a variety of competitive advantages over their rivals and to compete in the world market with bigger companies (Scupola, 2003). Nonetheless, the benefits associated with B2B EC depends on its level of adoption by SMEs (Elbeltagi, Hamad, Moizer, & Abou-Shouk, 2016; Hamad et al., 2018). The degree to which SMEs are prepared to adopt B2B EC is proportional to the benefits they obtain (Lin et al, 2007).

From a theoretical perspective, a review of the literature shows some researchers have been investigated to recognize and to measure the relationship between IT adoption and competitive advantage in organizations (Bhatt, Emdad, Roberts, & Grover, 2010). Similarly, most of these studies focused only on a single competitive advantage construct while other competitive advantage related dimensions were excluded (Gebauer & Schober, 2006; Seongbae & Silvana, 2014). Likewise, B2B EC adoption levels and implementation is recognized by several existing studies (Hamad et al., 2018); however, there have not been many studies as to how competitive advantages tend to be gain by adopting information technology at each stage. This study purposes to fill the gap in the literature. IT provides value to the organization, but the quantitative influence of IT on competitive advantage remains elusive. Since the empirical evidence is scant, this research uses an exploratory approach. Specifically, it employs canonical correlation analysis to explore the relationship between B2B EC adoption levels and competitive advantage.

The fundamental research question to be answered in this paper: Is there a positive relationship between levels of B2B EC adoption and measures associated with competitive advantage? Thus, in this research, we proposed a B2B EC adoption model that includes a multi-dimensional competitive advantage suggested by earlier research and to empirically test the relationship between the B2B EC adoption levels and competitive advantage in Ghanaian manufacturing SMEs.

LITERATURE REVIEW

The literature that relates to B2B EC adoption levels and competitive advantage provides the conceptual bases for this research.

Levels of B2B EC Adoption

The growth models recognizes that information technology, including B2B EC, in organizations is not static but involves many levels of development. Since the evolution of the internet in the 1990s, various researchers have proposed different types or levels of B2B EC adoption in SMEs (Chan & Swatman, 2004; Lefebvre, Lefebvre, Elia, & Boeck, 2005). It proposed through extant literature on B2B EC adoption that considers a staged development of usage that starts from simple initial adoption technology to a higher degree of use of more sophisticated and integrated technologies. SMEs are noted to usually begin with a simple static website which gives the enterprise an online presence by providing information about the organization, its services and contact details. Then the enterprise may introduce a dynamic online presence in a two-way communication channel between the firm and its suppliers and customers, which involves answering queries and receiving feedback. The third stage is electronic transaction, where there is an online order system supported by online payments. The final stage constitutes an online collaboration, where all business operations involving suppliers and supply chain partners are electronically integrated. Elbeltagi et al. (2016) in their study proposed a four-level process model. Level 1 is 'electronic information search and creation'. Companies in this level use the website to advertise their firm and its product/services as well as seeking out for new suppliers, new customers and new products. Level 2 is referred to as 'simple electronic transaction'. In this level, organizations undertake activities such as sells and buy products/services using electronic catalogues and transact online ordering. Level 3 deals with 'complex electronic transaction' in which companies make and receive electronic payments, customer's/supplier's having access to the company's inventories among others. The fourth level is 'electronic collaboration' that involves automation processes, and management information system. This model, however, did not consider basic B2B EC application that has to do with adopters using e-mail. Thus, existing research suggests that scholars design B2B EC adoption according to the functions of the websites. This current research adopts Elbeltagi et al. (2016) B2B EC adoption model which included four levels, however, recognizes basic B2B EC application like the use of

e-mail for business activities. Regarding the choice that individual SME owner/managers have to make when adopting B2B EC, it is relevant to measure the various competitive advantages they can attain from the use of information technology. It is worth noting there are limited studies in investigating the relationship between the different levels of B2B EC adoption nor on the multidimensional competitive advantage, which is the focus of this research.

Competitive Advantage

Competitive advantage is the degree to which a firm has the capability to create a secured position over its competitors as a result of a critical business decision, which differentiates itself from its rivals (Ghobakhloo et al., 2011). A firm is said to have a competitive advantage when it enjoys greater success than current or potential competitors in its industry. Competitive advantage is experienced by a firm when its activities in an industry or market creates economic worth and provides customers with greater values, by either selling at a lower prices or by offering unique benefits that offset a higher price than competitors for the same benefits (Al-alak & Tarabieh, 2011; Arungai, 2015; Wagner, 2006). Considering the growing level of competition in most industries and widespread usage of IT, adoption of IT by a firm would be more of a strategic need than any other reason. Likewise, IT has a significant effect on a business organization's performance such as market share and profitability. It also reduces costs of operation, fast delivery by suppliers, closed relationship with customers and business partners, and a tool in facilitating new methods of managing and organizing businesses (Khong, Sing, Binshan, & Uchenna, 2010; Melville, 2006).

IT is one of the important resources that can be used by SMEs to gain competitive advantage, and therefore, supports the organization's strategy to attain a competitive advantage against their competitors (Valacich & Schneider, 2010) and to remain competitive in both the local and global markets. Moreover, it is stated that IT is not the only tool that can attain a competitive advantage but can similarly aid in sustaining and promoting such advantages. A competitive advantage is based on capacities that offer the needed grounds of a firm to differentiate itself from its competitors, therefore; organizations must exploit IT including enterprise applications such as B2B EC (Marinagi et al., 2014).

Competitive advantage and its relation to information technology and communication adoption is extensively covered in the literature in terms of cost reduction, growth, differentiation and innovation. First, cost reduction is the most common dimension achieved by an organization for adopting IT. Cost reduction refers to realizing real and permanent reduction in the unit cost of goods manufactured or services (Mishra & Agarwal, 2010). Research on EC application in SMEs shows the adoption of electronic systems can reduce transaction costs (Ghobakhloo et al., 2011). Also, it has been found that adopting internet technologies can drastically save costs on obtaining and transmitting information, therefore, changing the way firms transact business (Guarda, Augusto, & Silva, 2012). Likewise, other studies have revealed that the adoption of internet technologies reduces the cost of marketing and sales, advertising, and operational costs (Hamad et al., 2018; Krell & Matook, 2009; Teo & Pian, 2003). For example, an organization can provide online customer services and technical support on its website by interacting with customers regarding product queries and other business activities.

Growth on the other hand, as described by Teo and Pian (2003) means improving business efficiency. It can also mean where an organization expand its market and customer share, therefore, facilitating the organization's growth strategy. IT adoption affects a firm's growth ability by increasing its scope and prolonging its core business through market penetration and development as well as enhancing business efficiency (Elbeltagi et al., 2016; Teo & Pian, 2003). The adoption of technology can help a firm increase market, increase sales and revenue. A firm can quickly and effectively expand its geographical markets locally and internationally (Bhatt et al., 2010; N'Da, Bergeron, & Raymond, 2008; Teo & Pian, 2003). Internet technology opens new markets and new distribution channels and customized products that enables an organization to form and develop customers' intimacy. Further, an information-rich website can help a firm to develop relationships with customers and suppliers that will increase the likelihood of sales and opportunities to introduce new products and services.

Differentiation means improving the credibility and image of the organization by providing unique value to its clients and help the organization distinguish its products and services from its competitors (Teo & Pian, 2003). Technology adoption helps a firm to differentiate itself not through price only but also through product innovation. Another example is that it enhances the reputation of the firm and provides new products and services customers better than its rivals (Elbeltagi et al., 2016). Likewise, technology adoption offers customers the freedom to customize products and services, fast track the process of transactions and makes customer information easily accessible, thereby improving its differentiation

advantage (Elbeltagi et al., 2016; Lederer, Mirchandani, & Sims, 1997; Lumpkin, Droege, & Dess, 2002). Furthermore, B2B EC provides an opportunity for a firm to establish its brand image. Firms can use websites to strengthen their identities, which is identified as one of the most influential tools in attracting market and customer share (N'Da et al., 2008; Teo & Pian, 2003).

Lastly, innovation could create impacts on one or more links of the value chain, which usually covers research and development (R&D), purchase and transportation of raw materials, marketing and sales (Teo & Pian, 2003). The influence of technology adoption on innovation can be classified into three parts. First, information gathering about customers' needs from the website can readily aid in the creation of new product ideas. Second, collaboration network within the firms as well as between the firms and its trading partners can facilitate R&D production process. Third, close relationship amongst trading partners can offer opportunities to enhance the product-distribution procedures. Internet adoption may offer organizations an opportunity to experiment with new products, services, and processes. All of these could be enhanced by using B2B EC.

Impact of B2B EC adoption levels on competitive advantage

The literature reviewed shows that organizations adopt information technology for a variety of reasons. In some organizations, it may be simply having an internet presence, whiles in others it may be purposely for business integration. Different levels of B2B EC adoption are therefore likely to confer different degrees of competitive advantage. Several existing studies have investigated the correlation between IT adoption and competitive advantage (Hazen & Byrd, 2012; Pavic, Koh, Simpson, & Padmore, 2007). In a study by Aldhmour (2007), he confirmed that ICT assisted manufacturing firms to sustain their competitive advantage by boosting their reputation and excellent customer service and information feedback, lowering costs, ensuring good relationship with suppliers and customers and helping with technical developments. Thus, ICT adoption and competitive advantage have shown to be strongly and positively correlated.

Also, a comparative study conducted by Elbeltagi et al. (2016) show how SMEs gain competitive advantage through each adoption levels and that a higher level of competitive advantage is gained when adopting a higher level of B2B EC. This stimulates growth that leads to increase in their market share and consequently improved their revenue growth and sales. Thus, greater competitive advantage is gained through the adoption of higher IT. IT adoption improves competitive advantage through increases in levels of efficiency and effectiveness (Hazen & Byrd, 2012). Some researchers are of the view that IT adoption enables firms to achieve competitive advantage through various paths (Aldhmour, 2007; Hazen & Byrd, 2012) however, they did not differentiate between the competitive advantages gained by each level of IT adoption. Previous EC research have not sufficiently addressed the competitive advantages resulting from adopting IT/IS at each level. This research aims to fill this literature gap.

From a theoretical perspective, earlier investigations have focused on extensive and generic view of EC adoption by SMEs (Elbeltagi et al., 2016) or the relationship between IT adoption and competitive advantage. This empirical research explores the relationship between B2B EC adoption and multiple dimensions of competitive advantage. In this research, competitive advantage is measured by cost reduction, growth, differentiation and innovation.

MATERIAL AND METHODS

Sampling and data collection

This study's analysis relates specifically to manufacturing SMEs in Ghana. We choose these firms as an area of study since they play a crucial and integral role to the economy of Ghana. A questionnaire survey was used to collect data from the respondents. In this research, we relied on the provisions of the Regional Project on Enterprise Development, Ghana to capture those businesses with less than 100 employees classified as small and medium-sized businesses. Data were gathered from owner or manager responsible for B2B EC activities. Normally, many of the data associated to SMEs is collected and kept by parties who are concerned in the operations of SME. For example, the Ghanaian government via the National Board for Small Scale Industries and the Registrar General Department provides some SME data in specific areas. Also, the Association of Ghana Industries (AGI) and Global Business Directorate (GBD) were other relevant sources of data to complete the sample frame. The data provided by these agencies were retrieved in their websites. To ensure that only manufacturing SMEs were selected for the sample frame, a list of 1124 manufacturing firms were randomly selected. After a systematic random procedure was applied to select a representative sample of 748, using the aggregation of product type and geographic locations as stratification criteria. Geographic locations were across four regions out of the ten regions in Ghana, namely; Greater Accra, Western, Ashanti, and

Eastern. These regions have highly urbanized centers made up of Metropolitan, and Municipal Assemblies and most industries are sited in these regions. The sampling frame is a cross-section of six industries, namely: construction and electricals, polymers and rubbers, textiles and clothing, pharmaceuticals and chemicals, food processing and beverages, and wood, tissues and paper products, in order to increase generalizability. With the help of fifteen research assistants, self-administered printed questionnaires were delivered by hand to selected sample firms. Follow-up telephone calls and e-mails were made to respondents as a reminder of the survey. After a 14-week period, the researchers validated a total of 315 responses that were free of missing data (an effective response rate of 42.1%) and having websites. Non-response recognized as a potential source of bias in survey research was evaluated by splitting the responses into early respondents and late respondents. The t-test results revealed that non-response bias was not a problem in this study.

For the levels of B2B EC adoption, 15 electronic business processes (eBPs) was categorized to measure the four levels of B2B EC adoption. The eBPs were adopted Elbeltagi et al. (2016) and modified based on the researchers' view and pilot study. Likert scale with values of 1-5 was employed to measure the dependent variables, with 1 – not at all and 5 – totally (see Appendix A). The proposed four levels of B2B EC adoption are electronic information (Level 1), electronic interaction (Level 2), electronic transaction (Level 3), and electronic collaboration (Level 4). Likewise, Likert scales of 1 -5, (with 1- strongly disagree, and 5 – strongly agree) were used to measure the impact of the adoption levels of B2B EC on different facets of competitive advantage: cost reduction, growth, differentiation and innovation. The selected items were adopted from other studies in order to capture the various dimensions more extensively as shown in Table 1. More than 53% of the responses were from Chief Executive Officers/owners, and the rest were from Heads of information technology departments. Following the Regional Project on Enterprise Development of Ghana classification, 65% of the respondents could be classified as "medium businesses". Besides, 71% of the respondents have been in business for more than ten years. The demographic profiles of the manufacturing SMEs who participated in this study are presented in Table 2.

The relationship between the B2B EC adoption levels and the measures of competitive advantage is examined using canonical analysis. This analysis is a multivariate statistical model that facilitates the study of interrelationships among sets of multiple criterion (dependent variables) and multiple predictor (independent) variables. Whereas multiple regression predicts a single dependent variable from a set of multiple independent variables, canonical correlation simultaneously predicts multiple dependent variables from multiple independent variables.

Table 1: Measurement of Competitive Advantage

Constructs	Items	Descriptions of items	Sources
Cost reduction (Cost)	Cost1	Reduce cost in communication	Teo and Pian (2003); Lederer et al. (1997); Elbeltagi et al. (2016); N'Da et al. (2008)
	Cost2	Reduce cost in marketing	
	Cost3	Reduce cost in advertising	
	Cost4	Reduce cost in information distribution	
	Cost5	Reduce cost in operational activities	
Growth (Grow)	Grow1	Enhance business efficiency	N'Da et al. (2008); Lederer et al. (1997); Elbeltagi et al. (2016)
	Grow2	Increase market share	
	Grow3	Increase customer satisfaction	
	Grow4	Better achieve organizational goals	
	Grow5	Access to new markets	
Innovation (Inno)	Inno1	Responding more quickly to change	Elbeltagi et al. (2016); N'Da et al. (2008); Teo and Pian (2003); Bhatt et al. (2010)
	Inno2	Better coordinate business operations	
	Inno3	Change the way firm conduct business	
	Inno4	Shorten the time period for product development	
	Inno5	Allow previously infeasible applications to be implemented	
Differentiation (Diff)	Diff1	Provide better and new products/services to customer	Elbeltagi et al. (2016); Lederer et al. (1997); N'Da et al. (2008); (Teo & Pian, 2003)
	Diff2	Provide easier customer access to information	
	Diff3	Provide customized products/services	
	Diff4	Enhance brand distinguishability	
	Diff5	Enhance the credibility and prestige of the firm	

Table 2: Demographic profiles of the manufacturing SMEs

Characteristics	Details	Percent
Type of Industry	Construction and Electricals	29.5
	Polymers and Rubbers	19.1
	Textiles and Clothing	14.9
	Pharmaceutical and Chemicals	13.3
	Food Processing, and Beverages	12.4
	Wood, Tissues and Papers Products	10.8
Firm size	5-29	40.3
	30 - 99	59.7
Education	Secondary level	1.0
	Tertiary level	44.8
	Postgraduate level	15.2
	Professional level	39.0
Gender	Male	74.3
	Female	25.7
Age	Less than 30 years	8.6
	30 – 39 years	49.5
	40 – 49 years	37.1
	50 years and above	4.8

Analytical Procedure

Exploratory Factor Analysis and Reliability

Exploratory factor analysis was executed to examine the factor structure of each construct. A principal component analysis with the orthogonal rotation

(Varimax rotation) was used in order to reduce the number of items and to facilitate interpretation (Hair, Ringle, & Sarstedt, 2011). This was conducted for the measures of both B2B EC adoption levels and competitive advantage dimensions. Also, Cronbach's alpha (α) value was required to measure internal consistency reliability which gives the degree of relatedness of the individual items. A recommended level of 0.70, indicating acceptable internal consistency reliability (Fornell & Bookstein, 1982) was exceeded. The result of the reliability test for the questions used for measuring the constructs showed the following: Level 1 α = 0.869; Level 2 α = 0.818; Level 3 α = 0.830; Level 4 α = 0.835; cost reduction α = 0.830; growth α = 0.841; differentiation α = 0.875; and innovation α = 0.803.

The Kaiser-Meyer-Olkin (KMO) and Bartlett's test for sample adequacy was also performed to assess the commonalities of the indicators. The number of factors indicators for each construct was determined, based on the eigenvalue greater than 1 criterion. In exception of one item (Inno4) that was eliminated, all other items retained had loadings above 0.50 on the factor as shown in Table 3. Cross loadings of factor indicators were sufficiently checked to find out the extent of correlations among the factor indicators, that is convergent and discriminate validity were checked to find out the internal consistency of the factor indicators.

Table 3: Factor loadings of B2B EC adoption and competitive advantage

Indicators	Level 1 (e-information)	Level 2 (e-interaction)	Level 3 (e-transaction)	Level 4 (e-collaboration)
Level1A	0.841			
Level1B	0.794			
Level1C	0.787			
Level1D	0.805			
Level2A		0.720		
Level2B		0.687		
Level2C		0.825		
Level2D		0.832		
Level3A			0.739	
Level3B			0.844	
Level3C			0.758	
Level4A				0.796
Level4B				0.782
Level4C				0.790
Level4D				0.720

Note: All loadings are above 0.50

Indicators	Cost reduction	Growth	Differentiation	Innovation
Cost1	0.657			
Cost2	0.749			
Cost3	0.722			
Cost4	0.693			
Cost5	0.730			
Grow1		0.881		
Grow2		0.889		
Grow3		0.865		
Grow4		0.701		
Grow5		0.758		
Inno1			0.751	
Inno2			0.632	
Inno3			0.775	
Inno5			0.728	
Diff1				0.819
Diff2				0.732
Diff3				0.762
Diff4				0.752
Diff5				0.783

Note: All loadings are above 0.50

Theoretical Considerations of Canonical Correlation Analysis

In canonical correlation analysis, components are extracted from two sets of variables in manner to maximize the correlation between these components. When one of the variable sets comprises of indicator variables, canonical correlation analysis is equivalent to discriminant analysis. Canonical correlation is used in examining the relationship between two sets of variables, that is the independent set which is usually denoted as X and dependent set which is also denoted as Y. Canonical correlation analysis emphasizes the relationship between a linear combination of the variables in one set (independent variable set) and the linear combinations of variables in another set (dependent set of variables). The object is then to find the linear combinations:

$$U = a_i^T X = a_{i1}X_1 + a_{i2}X_2 + ... + a_{ip}X_p \quad (1)$$

$$V = b_i^T Y = b_{i1}Y_1 + b_{i2}Y_2 + ... + b_{ip}Y_q \quad (2)$$

such that U and V have the biggest possible correlation. Such a linear combination can give insight into the relationships between the two set of variables. A distinctive way to view canonical correlation analysis is as an extension of the traditional multiple regression. In such case, the dependent set (Y-set) contains one variable instead of q variables and the regression solution involves the linear combination; $a^T X$ which in most cases is highly correlated with Y. While in the canonical correlation analysis, the dependent set (Y-set) contains $q \geq 1$ variables (that is multiple variables)

and we look for vectors a and b for which the correlations between the linear combinations ($a^T X$ and $b_i^T Y$) is maximized. With respect to this research, U and V are the canonical variates of B2B EC adoption levels and competitive advantage respectively. $X_1, X_2, ...X_p$ are latent variables of observed variables of observed variables of B2B EC adoption whilst $Y_1, Y_2, ...Y_q$ represents the latent variables of competitive advantage. The parameter estimates $a_{i1}, a_{i2}, ...a_{ip}$ and $b_{i1}, b_{i2}, ...b_{ip}$ are the canonical loadings for $X_1, X_2, ...X_p$ and $Y_1, Y_2, ...Y_q$ respectively.

Suppose X is a $p \times 1$ random vector and Y is also a $q \times 1$ random vector that is:

$$\begin{bmatrix} X_{p\times 1} \\ Y_{q\times 1} \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \\ . \\ . \\ x_p \\ y_1 \\ y_2 \\ . \\ . \\ y_q \end{bmatrix} \quad (3)$$

Suppose further that, X and Y have means μ_X and μ_Y respectively and that,

$$E\left[(X-\mu_X)(X-\mu_X)^T\right] = \sum_X$$
$$E\left[(Y-\mu_Y)(Y-\mu_Y)^T\right] = \sum_Y \quad ,$$
$$E\left[(X-\mu_X)(Y-\mu_Y)^T\right] = \sum_{XY} \quad = \sum_{YX}$$

Then by considering the two linear combinations $U = a_i^T X$ and $V = b_i^T Y$, the correlation between U and V is formulated as:

$$\rho_{(U,V)} = \frac{a^T \sum_{XY} b}{\left(a^T \sum_X a b^T \sum_Y b\right)^{1/2}} \quad (4)$$

where $\sum_X$, $\sum_{XY}$ and $\sum_Y$ are covariance matrices for X, Y and XY.

In testing the significance of the canonical correlation coefficient, the null and the alternative hypothesis are respectively stated as:

$$H_o : \rho_1 = \rho_2 = ... = \rho_p = 0$$
$$H_A : \rho_1 \neq \rho_2 \neq ... \neq \rho_p \neq 0 \quad (5)$$

In order to test the above hypothesis, the most widely used test statistic is the Wilk's Lambda which is given by the relation:

$$\Lambda = \prod_{i=1}^{p} (1-\rho_i) \quad (6)$$

The critical value (p-value) for the test is obtained from F-distribution with a specific level of significance (α). If the probability value (p-value) of the test is small (less than the level of significance (α)) then it indicates the rejection of the null hypothesis, which implies the two set of variables are dependent or correlated.

The choice of canonical correlation analysis was appropriate since the researchers desired to examine the relationship between two variables sets. This technique can minimize the threat of committing Type 1 error. It permits for simultaneous comparisons among sets of variables rather than requiring many statistical tests to be performed (Thompson, 1993). Moreover, this technique can be used instead of other parametric tests in many cases, making it not only a suitable method to use but a comprehensive method as well. Henson (2001) and Thompson (1993) have stated that virtually all of the parametric tests most often used by researchers (e.g. ANOVA, MANOVA, Multiple regression, Pearson correlation, t-test, and Discriminant analysis) can be subsumed by canonical correlation analysis as particular case in the General Logistic Models (GLM).

RESULTS

The objective of this analysis was to use all eight variables as input data. The B2B EC adoption levels (Level 1, Level 2, Level 3, and Level 4) are specified as the set of multiple independent variables or the predictor variables. The measures of competitive advantage (cost reduction, growth, differentiation

and innovation) are designated as the set of multiple dependent variables or the criterion variables. The statistical difficulty involves identifying any latent relationships between a respondent's perceptions about the B2B EC adoption level construct and the measures of competitive advantage. The analysis of the data in this research shows a definite relationship between these two sets of constructs. This provides some evidence that B2B EC adoption is related to competitive advantage. Canonical correlation must be analyzed systematically to have confidence in the results. The first step is to determine the multivariate test of significance. Most researchers generally, prefer to interpret the result of the multivariate test of significance on the basis of Wilk's Lambda due to its high level of practicality (Sherry & Henson, 2005). The results from Table 4 collectively indicate that the full canonical model across all functions using the Wilk's Lambda **(λ)** = 0.58246 criterion, with F (16, 938.54) = 11.35261, P< 0.000) is statistically significant. This result is further supported by the other tests (Pillai's trace, Hotellings, and Roy's) which have their respective p-values being less than the 0.05 level of significance. Since the Wilk's Lambda represents the variance unexplained by the model, then 1-λ yields full canonical model effect or the amount of variance explained by the full canonical model. Hence, for the full canonical model obtained, the effect size or the amount of variance explained is 0.32914.

The next step in investigating the result was the eigenvalues and the canonical correlations. The Eigenvalues and canonical correlations help in making decisions on which canonical function has the maximum correlation and also significant based on their respective shared variances (canonical correlation squared values). Table 5 shows the root number representing the number of canonical functions generated, percentages, cumulative percentages, canonical correlation values and the squared canonical values of the respective canonical functions generated. It can be seen under the "Root No." column from Table 5 that, four (4) canonical functions were derived from the canonical correlation analysis. Also, among the four canonical functions obtained from the analysis, the first canonical function with the root number 1, had the largest Eigenvalue (0.49062), and highest canonical correlation value (0.57370) with a relatively significant amount of shared variance (32.9%) between the first and second set of variables used in the analysis. This followed by the second canonical function (Root No. 2), having an eigenvalue of 0.13924, a canonical correlation value of 0.34961 with shared variance (squared canonical correlation value) of 12.2% between the two sets of variables. Likewise, the third canonical correlation function having a shared variance of 1.0 % between the two sets of variables. The fourth canonical function had the least Eigenvalues as well as the least canonical correlation value and the least shared amount of variance between the two variable sets.

Furthermore, the dimension reduction analysis is the other step used to identify the extent to which each canonical function can account for the shared variance between the data sets and also permit the researchers to test the hierarchical arrangements of functions for statistical significance. The results in Table 6 concerning the dimension reduction analysis, shows that two canonical functions are statistically significant with the p-value of less than 0.01 level. However, the first canonical function (1-4) can be considered noteworthy and significant since it has the root with the maximum correlation value of 0.49062. Explaining 32.9% of the variance in an organization level study can be reasonably significant considering all the other variables that can contribute to performance measures. The second canonical function (2-4) is significant but too low to be of practical importance (shared variance of 12.2%). It can also be observed from the same table that functions 3 - 4 and 4 - 4 did not explain a statistically significant amount of shared variance between the variable sets hence insignificant as their respective probability values are greater than the five per cent level of significance. Because of the significance of the overall canonical function and the reasonable canonical correlation squared value, the first function is accepted.

Table 4. Multivariate test of significance

Test name	Value	Approx. *F*	Hypothesis DF	Error DF	Sig. of *F*
Pillai's	0.46226	10.12646	16.00	1240.00	0.000
Hotellings	0.64086	12.23684	16.00	1222.00	0.000
Wilks'	0.58246	11.35261	16.00	938.54	0.000
Roy's	0.32914				

Table 5. Eigenvalues and Canonical Correlations

Root No.	Eigenvalue	Percentage	Cumulative %	Canonical Correlation	Canonical Correlation Squared
1	0.49062	76.55559	76.55559	0.57370	0.32914
2	0.13924	21.72763	98.28323	0.34961	0.12223
3	0.01045	1.62991	99.91314	0.10167	0.01034
4	0.00056	0.08686	100.00000	0.02359	0.00056

Table 6: Dimension Reduction Analysis

Roots	Wilks L	F	Hypoth. dF	Error dF	Sig. of F
1 TO 4	0.58246	11.35261	16.00	938.54	0.000
2 TO 4	0.86822	4.98021	9.00	749.74	0.000
3 TO 4	0.98911	0.84804	4.00	618.00	0.495
4 TO 4	0.99944	0.17256	1.00	310.00	0.678

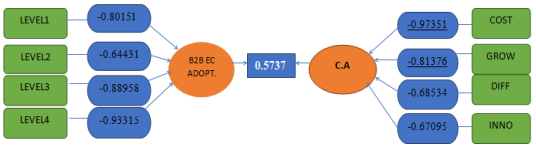
With the canonical relationship deemed statistically significant, the magnitude of the canonical root and redundancy index acceptable, the analysis now turns to the substantive interpretation of the results. The two methods for interpretation are (1) canonical weights (standardized coefficients) and canonical loadings (structural coefficients). Table 7 shows all two indices. The squared structure coefficients (r_s^2), represents the percentage of shared variance between the two sets of variables. Variables with r_s^2 value of 0.45 and above are said to contribute in a significant way to the dataset in which they are included. As shown in Table 7, variables with structure coefficients above the absolute value of 0.45 (i.e. $|0.45|$) are underlined and are relevant (significant). Further, all the variables within the dependent set, classified to be relevant (significant) have structure coefficients with the same sign, indicating they are all positively related to the predictor variables. Likewise, all variables in the predictor set compared to the dependent set are relevant (significant), since their respective structure coefficients are more than $|0.45|$. As can be observed from Table 7, all the structure coefficients r_s of the variables in the predictor set have the same signs as that of the variables in the dependent set (criterion set). From the results, it implies the predictor variables: Level 1, Level 2, Level 3, and Level 4 are positively related to the measures associated with competitive advantage. Therefore, the canonical correlation coefficient (R_C) which measures the strength of the relationship between the dependent set (criterion set) and the independent set (predictor set) is 0.32914. Therefore, there exists a strong positive correlation between competitive advantage and B2B EC adoption levels with a shared variance of 32.9% which is indicated as R_C^2 (Canonical correlation coefficient squared). The structural model of these results is illustrated in Figure 1.

Table 7: Results of the redundancy for the First Canonical Function

Variables	First (1st) Canonical Function		
	Coefficient	r_s	r_s^2(percent)
Predictor set- B2B EC adoption			
Level 1	-0.13124	-0.80151	64.24
Level 2	0.42080	-0.64431	41.51
Level 3	-0.62005	-0.88958	79.13
Level 4	-0.65835	-0.93315	87.08
R_c^2	**32.9**		
Criterion set – competitive advantage (CA)			
Cost reduction (Cost)	-0.98096	-0.97351	94.77
Growth (Grow)	-0.40012	-0.81376	66.22
Differentiation (Diff)	0.33816	-0.68534	46.97
Innovation (Inno)	0.07277	-0.67095	45.02

Note: Structure coefficients (r_s) greater than $|0.45|$ are underlined. Coefficients= standardized canonical function coefficients; r_s=structure coefficients; r_s^2= squared structure coefficients

Figure 1: Structural model of the First Canonical Function of the correlation between B2B EC adoption levels and competitive advantage



DISCUSSION AND CONCLUSION

The outcome of the canonical correlation analysis in this study point to a relationship between B2B EC adoption and competitive advantage. All of the indicators of the canonical analysis are strong and explicit. It can be said that B2B EC adoption as measured by e-information (Level1), e-interaction (Level 2), e-transaction (Level 3) and e-collaboration (Level 4) is positively related to the organizational measures of competitive advantage of cost reduction, growth, differentiation and innovation. This research also gives more information about the strength of contribution of each B2B EC adoption level to the relationship. Concerning the predictor variables, Level 4, Level 3 and Level 1 are the primary contributors to the relationship based on their respective structure coefficients being greater than 45 per cent with Level 2 being a secondary contributor. Also, the analysis shows that e-collaboration contributes the most among the adoption levels to the relationship, followed by e-transaction and then e-information. These findings are congruent with that of Elbeltagi et al. (2016) and Byrd and Turner (2001) who revealed that adopting a higher level of B2B EC leads to a greater competitive advantage. Therefore, it is logical to assume that the higher the level of

technology adoption, the more competitive advantage a firm obtains. However, despite the obvious hierarchy of importance among the B2B EC adoption levels, it is important to note that all four constructs contribute to the positive relationship to the measures of competitive advantage. Therefore, any future studies investigating this relationship should include all four variables. Although the findings seem to be comparable to previous studies literature, the dynamic nature of technology adoption could change the order of importance in the future when issues of technology advancement are not encouraged. It is clear that Ghanaian manufacturing SMEs' B2B EC adoption levels affect competitive advantage and each level has a significant and positive relationship with the measures of competitive advantage. There are limitations in our findings. The relationship between B2B EC adoption and competitive advantage needs much more attention. The reason for this research was to explore the possibility of a positive relationship between the two. A much more rigorous investigation must be conducted to establish antecedent and resultant relationships between these two constructs.

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Appendix A: Measurement items of B2B EC adoption levels

Constructs name	Description	Items
Electronic information (Level 1)	Providing general information about the firm	Level1A
	Promoting the firm's products and services	Level1B
	Communicating and responding with suppliers and/or customers by email	Level1C
	Seeking out new customers and/or suppliers	Level1D
Electronic interaction (Level 2)	Responding to customers and/or suppliers enquiries and feedback	Level2A
	Placing and managing orders with suppliers	Level2B
	Receiving and managing orders with customers	Level2C
	Offering customers, after-sales service	Level2D
Electronic transaction (Level 3)	Receiving electronic payments from customers	Level3A
	Making electronic payments to suppliers	Level3B
	Negotiating contracts (price, volume) with suppliers and/or customers	Level3C
Electronic collaboration (Level 4)	Using management information systems to enhance quality assurance	Level4A
	Using extranet to communicate with key suppliers	Level4B
	Transferring documents and technical drawing to suppliers	Level4C
	Tracking products (purchased and sold) during transportation	Level4D