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eERP SYSTEM USAGE AND SUPPLY CHAIN PERFORMANCE IN MANUFACTURING FIRMS IN KENYA

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Abstract

This study aimed at establishing the effect of eERP system usage on supply chain performance (SCP) in manufacturing firms in Kenya. The study was anchored on positivism philosophy. The dependent variable, SCP was measured through quality, time, reliability, cost savings and market share. eERP system as the independent variable was measured through extent of integration and extent of usage. Using a descriptive research design approach, the study gathered primary data; the collection tool used being a semi-structured questionnaire. Both variables used categorical approach and a 5-point Likert scale. The hypothesis was tested using a logistic regression because it was able to handle categorical data in establishing the relationship between dependent and independent variables. The logit model, probit model and linear regression were used in testing the study hypothesis. The study findings proved that eERP system usage had an effect on SCP as shown by the three different predictive equations $SCP = 2.892 + 0.473eERP$ from logit analysis; $SCP = 1.637 + 0.243eERP$ from probit analysis; and $SCP = 2.756 + 0.272eERP$ from linear regression analysis. This paper expanded the body of research on eERP system usage by demonstrating that there is a significant relationship between eERP system usage and supply chain performance with a conclusion that integrating eERP system among supply chain partners would improve SCP of various manufacturing firms in Kenya. This research shows that manufacturing firms that are most successful in the market have a great extent of eERP system usage across their supply chain. Therefore, manufacturing firms in Kenya must at least have a mechanism of ensuring that their eERP system usage is fully operationalized within their supply chain environment. This study only looked at the manufacturing firms in Kenya yet the eERP system is used across many sectors of the economy. Future studies should investigate the relationship between eERP system usage and SCP in other sectors of the economy in Kenya.

Keywords: eERP, SCP, manufacturing firms, Kenya.

Introduction

Research has shown that eERP system usage improve performance of organisations (Incea, Salih, Halit, Aliekber, & Efee, 2019; Kibiru, Adhiambo, 2018). The ERP systems have received different definitions, the common description being a useful strategic tool used by organisations to build capabilities, aid in decision making, improve performance and attain a competitive advantage (Bambang et al, 2020). According to Ali and Hajj (2019) an ERP system refers to a customizable standard business application that comprises of integrated solutions for business, to core business processes such as warehouse administration, human resource management and accounting. Al-Mashari (2018) defines ERP system as an all-inclusive packaged business software solution that tends to integrate a full and complete set of organizational functions and processes so as to present a holistic view of the firm from a central information and information technology architecture. On the other hand, Jilani (2018) defines ERP system as a software that integrates numerous departments of an entity into one unit. Therefore, an ERP system is an integrated business software with different modules each aimed at a different function in the organisation (Ali & Miller, 2019).

The current trend is towards extended enterprise resource planning, abbreviated as eERP or ERP II, system (Al-Mashari, 2018). The eERP is considered a strategic information system (SIS) that integrates a business firm with its supply chain partners by merging the ERP system software with other softwares and business processes such as SCM software and customer relationship management (CRM) software (Al-Mashari, 2018). Therefore, an eERP is an inter-organisational ERP system. The manufacturing sector plays an important role in Kenya's economic growth. During

Madaraka day speech on 1st June 2018, the President of Kenya, cited Kenya's Big 4 Agenda as being; manufacturing, universal healthcare, food security and affordable housing. Great emphasis was put on the manufacturing sector as being the key driving force towards Kenya's development and economic growth to achieve a Growth Domestic Product (GDP) of 15 percent by 2022 (Kenya Association of Manufacturers (KAM), 2018).

Many ERP system providers today, have quickly recognized the need to integrate SCM and CRM software with ERP systems software as being crucial. As such, today, SCM software are being added to the current ERP system solutions to act as modular improvements (Ali & Miller, 2019). Three key techniques for integrating SCM programs with ERP system packages being conformity, use of middle ware software or use of turnkey solutions (Marika, Litondo & Njihia, 2018).

Problem of Research

In developing countries such as Kenya, limited research exists on eERP system usage with emphasis on the role played by eERP in achieving SCP. Evidence from literature indicates that most previous studies (Carl & Labuschagne, 2019; Al-Mashari, 2018) have majorly been conducted in advanced countries such as America, Europe and Asia whose settings are undoubtedly different from those in developing countries like Kenya where the technological infrastructure required for ERP implementation is not as developed. Studies carried out in Kenya mainly had their focus on internal critical success factors (CSF) and challenges of implementing the ERP system (Ouma, 2019; Ombati, 2018) but have failed to demonstrate how manufacturing firms and use of eERP systems influence their supply chain performance.

Since both local and international studies have captured very little on factors of eERP system usage that directly influence the SCP, the present study did therefore broadly explore the factors focusing on the manufacturing sector. This study attempted to respond to the above-mentioned gaps by answering the research question; does eERP system usage have an effect on the SCP in the various firms in Kenya's manufacturing industry?

Objective

The objective of this study was to find out the effect of eERP system usage on supply chain performance in manufacturing firms in Kenya. To achieve the objective the study set a question; how does eERP system usage affect supply chain performance in manufacturing firms in Kenya? Consequently, the study set up a null hypothesis H_{01} : The eERP system usage has no significant effect on SCP.

Literature Review and Research Focus

The study was anchored on the virtual integration theory. The virtual integration theory proposes substitution of ownership with partnership whereby supply chain partners are integrated through use of information technology for tighter collaboration (Marika et al, 2018; Kang & Moon, 2017). Virtual integration ensures visibility of information among the partners. VIT, which lays emphasis on both process and system integration, can be used to understand how eERP systems can be well incorporated by various supply chain partners so as to boost SCP. The VIT assumes the supply chain partners have common goals and objectives and free flow of information (Hsin-Lu Chang, 2019).

A business firms' supply chain is the linkage of all its activities, employees, resources and technologies used in the procuring, processing, distribution and sale of its

products to its customers (Shatat, Udin & Aman, 2018) while performance refers to how well a particular activity has been carried out (Chan, Ngai & Moon, 2017). Performance measurement is increasingly receiving a lot of attention by business firms as evaluation of performance affects setting of future strategies, goals and objectives for the tactical, strategic and operational levels of the organisation.

The supply chain operation reference (SCOR) model and also the supply chain maturity model are business tools used to manage product life cycle and measure supply chain processes respectively (Kang & Moon, 2017). Another strategic tool that measures a firms' financial and non-financial metrics is the balanced score card which looks at outcome drivers and outcome measures (Carl & Labuschagne, 2019). A common practice however, is to measure SCP using metrics or indicators. Some of the indicators of SCP are response time, order cycle time, delays, order lead time, delivery rate, cost saving initiatives, logistics costs, product development cycle, product quality, product range, idle production times, wrong orders, customer complaints, defects and returns (Mogikoyo, Magutu & Dolo, 2017).

Manufacturing firms have become highly networked supply chains and are also early adopters of information technology (TATA Consultancy Services, 2017). Information systems used by manufacturing firms have evolved over time from Materials Requirements Planning (MRP) systems that were IT systems used in scheduling during production and in inventory planning; to Manufacturing Resource Planning (MRP II) systems which encompassed planning for personnel capacity, materials planning, machinery and plant size, e-business and business intelligence to the ERP systems that integrate all of an organisation's functions and most recently, to eERP systems that

integrates an organisation with its supply chain partners (Ali & Miller, 2019; Adejare, Shahzad & Hassan, 2018). Even though ERP system has other legacy systems like accounting, its genesis is rooted in manufacturing (Marika et al, 2019). Therefore, this study examines eERP system usage and SCP on a sample of 269 manufacturing firms as per the categories set out by KAM (KAM, 2018).

Methodology of Research

The study employed a positivist research paradigm so as to objectively collect and analyse data collected as drawn by the relationships existing among the variables as established in literature review. A descriptive cross-sectional research design method was employed.

Sample of Research

The target population was proportionately divided into stratas as per the current 13

sectors listed by Kenya Association of Manufacturers (KAM, 2020). Then a proportionate sample was derived from stratum based on the equivalent number of firms in Kenya’s manufacturing industry in each of the sectors as set out in Table 1. Sampling was done using sampling size determination criteria proposed by Krejcie and Morgan (1970). At a 95 percent confidence level, a population of 903 firms could best be represented by a sample of approximately 269 manufacturing companies. Through the data captured, the study used the results from the KAM registry to draw up relevant conclusions and recommendations which would later be inferred to other manufacturers in Kenya. Table 1 presents the main stratification of Kenyan manufacturing sector. The table also shows how the sample size was obtained from the population.

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Table 1:Sample Size Determination

Sectors	Total	Sample Size	Percent
Food and Beverages	234	70	26
Metals and Allied	96	29	11
Plastic and Rubber	90	27	10
Chemicals and Allied	90	27	10
Paper and Board	82	24	9
Textiles and Apparels	73	22	8
Motor vehicles and Accessories	59	18	7
Energy, Electrical and Electronics	58	17	6
Building, Mining and Construction	39	12	4
Pharmaceutical and Medical Equipment	30	9	3
Timber, Wood and Furniture	30	9	3
Fresh Produce	13	4	1
Leather and Footwear	9	3	1

Total	903	269	100
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Instrument and Procedures

The research instrument (the questionnaire) was developed from pertinent literature in line with the research objectives. The questionnaire had both closed ended and open questions to allow for structured and in-depth responses. The questionnaire was administered using drop and pick method. The researcher targeted heads of information technology department and heads of operations or supply chain department as respondents. This is because these departments were directly involved in use of eERP system in the supply chain.

Data Analysis

The data was cleaned and coded after which the researcher used descriptive and

inferential data analyses. Data were analysed using the logit model and probit models.

Results of Research

Both descriptive and inferential techniques were used to analyse data and results presented.

Descriptive of the Study Constructs

From Table 2 below presents descriptive statistics on various types of eERP Systems used in organisations, level of integration of firms with supply chain partners, method of integration, if a firm transacts business using eERP system and years of usage of eERP system.

Table 2: Descriptive Statistics on Extended Enterprise Resource Planning System Usage

Study Variable	Indicator	Frequency	Percent
Type of information system used in the organisation	Commercial ERP system	163	70
	Standalone systems	37	15.9
	Applications that share common database	33	14.2
	Total	233	100
Type of ERP system used in the organisation	SAP	83	35.6
	Oracle	21	9
	Infor	14	6
	Microsoft Dynamics	13	5.6
	Epicor	8	3.4
	BAAN	6	2.6
	Infor Global Solutions	6	2.6
	PeopleSoft	5	2.1
	J. D. Edwards	3	1.3
	NetERP	3	1.3
	Lawson Software	3	1.3

	Others	10	4.3
	None	58	24.9
	Total	233	100
Level of eERP integration in the supply chain	Yes	163	70
	No	70	30
	Total	233	100
Method of integration	Middleware	106	45.5
	Conformity	34	14.6
	Turnkey solution	20	8.6
	None	73	31.3
	Total	233	100
Transacting using eERPs	Yes	155	66.5
	No	78	33.5
	Total	233	100
Years of eERP usage	Below 20 years	67	33.5
	Over 80 years	27	11.6
	Total	233	100

Source: Empirical Data, 2021

Logit, Probit and Linear Regression Tests

To establish the study results, independent and dependent variables were measured using a likert scale scale of 1 to 5 with 1 as strongly disagree, 2 as disagree, 3 as neutral, 4 as agree, and 5 as strongly agree. Inferential statistics to establish hypothesis testing using three models: Logit, Probit and Linear regression.

The goodness of fit indicated in Table 3 shows a log likelihood^b of 3.728 implying that the model was fit to predict the effect of the predictor (independent) variable (eERP usage) on the criterion (dependent) variable (SCP). Bayesian Information Criterion (BIC) indicates that other factors held constant, eERP system usage as an independent variable once effectively and efficiently integrated was responsible for 18.348

positive change in SCP of the various firms in Kenya's manufacturing industry. The Omnibus test outlined in Table 3 examines overall significance of the model and it indicates chi-square value is 14.612, that is greater than 3.84 at one degree of freedom ($p(0.005) < 0.05$) hence rejecting the null hypothesis (H_{01}), meaning that eERP system usage significantly influenced SCP. Table 3 indicates that both the intercept and eERP system usage were significant because p-values were less than 0.05 and prediction equation was $SCP = 2.892 + 0.473eERP$ meaning that eERP system usage has a 47.3 percent chance of increasing SCP. Table 3 below presents logit results of hypothesis testing.

Table 3: Logit Model on Effect of Extended Enterprise Resource Planning System Usage on Supply Chain Performance

(a) Goodness of Fit ^a						
	Value	Degrees of Freedom	Value/Degrees of Freedom			
Deviance	.000	0				
Scaled Deviance	.000	0				
Pearson Chi-Square	.000	0				
Scaled Pearson Chi-Square	.000	0				
Log Likelihood ^b	3.728					
Akaike's Information Criterion (AIC)	11.455					
Finite Sample Corrected AIC (AICC)	11.507					
Bayesian Information Criterion (BIC)	18.348					
Consistent AIC (CAIC)	20.348	0				
(b) Omnibus Test ^a						
Likelihood Ratio Chi-Square	Degrees of Freedom		Sig.			
14.612	1		.005			
(c) Parameter Estimates						
	B	95 Percent Wald Confidence Interval		Hypothesis Test		
		Lower	Upper	Wald Chi-Square	Degrees of Freedom	Sig.
(Intercept)	2.892	1.328	4.457	13.128	1	.000
eERP system usage	0.473	0.834	1.781	5.031	1	.005
a. Criterion variable: SCP						
b. Explanatory variable (constant), eERP system usage						

To confirm result findings, the probit models was also used in examining the association between eERP system usage and SCP. The result findings presented in Table 4 show a chi-square of value of 4.794 for eERP system

usage. Since $(p(0.005) < 0.05)$, then eERP system usage had a significant effect on SCP of firms in Kenya's manufacturing industry. Consequently, rejecting the null hypothesis (H_{01}); therefore, eERP system usage has an

effect on SCP. The prediction equation was $SCM = 1.637 + 0.243eERP$ meaning that a unit change in eERP system usage increases,

on average, SCM by 0.243 units. Table 4 presents probit results of hypothesis testing.

Table 4: Probit Model on Effect of Extended Enterprise Resource Planning System Usage on Supply Chain Performance

a) Goodness of Fit ^a						
	Value	Degrees of Freedom	Value/Degrees of Freedom			
Deviance	.000	0				
Scaled Deviance	.000	0				
Pearson Chi-Square	.000	0				
Scaled Pearson Chi-Square	.000	0				
Log Likelihood ^b	3.728					
Akaike's Information Criterion (AIC)	11.455					
Finite Sample Corrected AIC (AICC)	11.507					
Bayesian Information Criterion (BIC)	18.348					
Consistent AIC (CAIC)	20.348	0				
b) Omnibus Test ^a						
Likelihood Ratio Chi-Square		Degrees of Freedom	Sig.			
14.612		1	.005			
c) Parameter Estimates						
	B	95 Percent Wald Confidence Interval		Hypothesis Test		
		Lower	Upper	Wald Chi-Square	Degrees of Freedom	Sig.
(Intercept)	1.637	0.827	2.447	15.686	1	.000
eERP system usage	0.243	0.932	0.445	4.794	1	.005
a. Criterion variable: SCP						
b. Predictor Variables: (constant), eERP system usage						

A linear regression was also carried out with eERP system usage as the predictor variable and SCP as the criterion variable. The results are shown in Table 5. The linear regression model summary results presented, depicts a

R-square of 0.20 thus inferring that, eERP system usage explained 20 percent of SCP among the various firms in Kenya's manufacturing industry, with other factors held constant. Other variables not included in

the model are explained by the remaining 80 percent variation. Regarding the overall significance, the $(p(0.000) < 0.05)$ showing that model the model was significant as stipulated in Table 5. Thus, the null hypothesis (H_{01}) that eERP system usage did not significantly affect SCP was rejected. The findings assert that eERP system usage has a significant effect on SCP among the business firms in Kenya’s manufacturing industry. Further, Table 5 shows that the constant and

eERP system usage were significant as their p-values were less than α -value of 0.05. The resulting linear regression predictive was $SCM = 2.756 + 0.272eERP$ meaning on average, a unit change in eERP usage increases SCP by 0.272 units. Table 5 presents linear regression results of hypothesis testing.

Table 5: Linear Regression Analysis of Extended Enterprise Resource Planning System Usage and Supply Chain Performance

(a) Model Summary						
Model	R	R Square	Adjusted R Square			
1	.141 ^a	0.20	0.16			
(b) Goodness-of-Fit ANOVA						
Model		Sum of Squares	Degrees of Freedom	Mean Square	F-value	Sig.
1	Regression	7.458	1	7.458	4.686	.000 ^b
	Residual	367.641	232	1.592		
	Total	375.099	233			
(c) Beta Coefficients						
Model		Unstandardized Coefficients	Standardized Coefficients	T-value	Sig.	
		B	Beta			
1	(Constant)	2.756		5.201	.000	
	eERP usage	0.272	0.141	2.165	.031	
a. Criterion variable: SCP						
b. Predictor Variables: (constant), eERP system usage						

Summary of Hypothesis Testing

The study hypothesis was; H_{01} : The eERP system usage has no significant effect on SCP
 From the analysis above, the three results: logit, probit and linear regression confirm that eERP system usage has an effect on SCP as shown by the three different predictive equations were $SCM = 2.892 + 0.473eERP$ from logit analysis; $SCM = 1.637 + 0.243eERP$ from probit analysis; and $SCM = 2.756 + 0.272eERP$ from linear regression analysis.

Discussion

In this article, eERP system usage was considered as an independent variable that influences the SCP among various firms in Kenya’s manufacturing industry. The various aspects of eERP system are were analysed as guided by the studies carried out by Sundtoft Hald and Mouritsen (2019) in their study that examined eERP planning, operations and management. In this study, seventy percent of the manufacturing firms adopted the commercial eERP system for their

organizations. This is similar to Jilani (2019) findings which indicated that sixty percent of the organizations used SAP R/3.

This study also indicated that forty percent had integrated their eERP system with the various supply chain partners. Similarly, Adhiambo and Akeyo (2018) found about forty-three percent of the studied firms had partially integrated the eERP with the supply chain partners. Middleware was confirmed to be the most preferred method used to integrate IS system with supply chain partners with a rating of about sixty six percent, is similar to Al-Mashari (2018) rated middleware as one of the most common method of integrating their IS systems with the supply chain partners in most developing countries and Bigsten et al. (2018) indicated that on average, over two thirds of the manufacturing firms in Kenya have been transacting their business with other supply chain partners by use of eERP to gain a competitive advantage. Outcomes of this study stipulated that eERP among supply chain partners had a positive effect on SCP. Similarly, Li, Wu and Incea (2017) argued that a number of factors interact to affect eERP usage and this influences the SCP. A study carried out in 283 Chinese manufacturing firms found that the organizational preparedness, positive benefits and costs perception, and external influences (such as and partner readiness, competitive pressure and environmental uncertainty) would facilitate inter-organizational knowledge sharing, which in turn, would increase ERP implementation effectiveness.

The effective implementation of eERP was found to influence the product quality by 65 percent, cost saving by 55 percent, supply chain responsiveness by 80 percent and order delivery performance by 66 percent. Ali and Hajj (2019) did a study on 50 manufacturing firms in Lebanon and the findings depicted

that a large percentage business firms in Lebanon currently embrace usage of the eERP systems to improve their performance. This shows that, over time, the use of ERPs has proved to have considerable impact on the performance of firms that employ it. Incea et al (2019) have indicated that ERP is a crucial tool for organizational processes planning, executing and controlling, information flowing, concerning the sources of the firm's (equipment, labor, financial, material.) deployed premises in diverse places. Similarly, Bigsten et al. (2018) in their study on the effect of ERP system and supply chain practices on the competitive advantage and performance of the firm in Indonesia and found that eERP integration had a significant influence on the SCP at 85 percent.

Mary (2020); Adhiambo (2018) argued that eERP system allows for improved quality and visibility of information that is needed in making decisions promptly thus improving SCP. Moreover, Incea et al (2019) demonstrated that an eERP system can provide high value to any business enterprise that aims to achieve smooth planning and execution of operations, which is geared towards achieving long-term organization profitability and maintaining a sound competitive edge. With the use of eERP system, it is possible for firms to monitor the status of all the operations at any time and take appropriate corrective actions where necessary. From the findings, it is evident that integration of the supply chain using the eERP system boost SCP. This is in line with the virtual integration theory which emphasises on tighter collaborations of supply chain partners through the use of Information Technology that enables visibility and free flow of information hence improved performance.

Conclusion and Recommendations

In relation to the background of the study, literature reviewed, data collected and analysed, the researcher makes the following conclusions: eERP usage has a significant effect on SCP. It was concluded that integrating eERP system among supply chain partners will improve SCP of various manufacturing firms in Kenya. Therefore, the budget allocated for information technology should be increased. Similarly, top management should support activities linked to eERP system usage so as to achieve improvements in SCP. Further, the knowledge held by the various players in relation to information system and information technology integration has an influence on both eERP system usage and SCP.

It is the recommendation of this study that eERP systems should be implemented and used in all manufacturing firms and their supply chains so as to improve SCP and consequently to achieve a GDP of 15% in support of Kenya's Big4 agenda by the Kenyan manufacturing firms. Therefore, the government should set up policy to ensure all manufacturing firms and their supply chain partners increase eERP system usage so as to achieve the Big 4 agenda. Consequently, eERP systems should be implemented across the supply chain in order to achieve improved SCP.

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