Adoption of Enterprise Resource Planning Systems in Kenya: A Case of Selected Manufacturing Firms in Nairobi Metropolitan

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Abstract

Although the manufacturing sector in Kenya faces low productivity levels, stiff competition and high production costs, firms are still using inefficient technology. Enterprise Resource Planning (ERP) system can enhance efficiency through integration and sharing of business processes in real-time. This study was done to determine factors that influence ERP adoption among corporate members of Kenya Association of Manufacturers (KAM) that operate within the Nairobi Metropolitan. Questionnaires were administered to 141 KAM members whereas 17 ERP firms were interviewed. Logit model was used to estimate the influence of the factors on ERP adoption. Organizational composite factor was found to be an important factor, whereas the planned change, business environment and ERP attributes factors were weak predictors of ERP adoption. The findings will benefit scholars, government, vendors and users of ERP system. Further research was recommended to investigate the weak factors.

Keywords: Enterprise Resource Planning system, Adoption

1. Introduction

According to Koch (2006), Enterprise Resource planning (ERP) system is a system that integrates all departments and functions across a company onto a single computer system that can serve all departmental needs. Additionally, Addo-Tenkorang and Helo (2011) observe that an enterprise resource planning system is universally accepted in the corporate world as a practical solution for purpose of facilitating smooth flow of common functional information and practices across entire organization. In the foregoing definitions, an ERP system can therefore be defined as a collection of an application that cover a wide variety of an organization's business functions, such as production, inventory, finance, human resource, among others, and consequently presents them as a monolithic system for purpose of enhancing operational efficiency and effectiveness.

The history of Information systems indicate that many business organizations incrementally developed in-house system solutions in such a way that each system had its own files and database with loose and awkward integration. According to Jeffrey *et al,.* (2002), business organizations tried to integrate their legacy information systems, usually with poor results, to form a single integrated information system. As the momentum for shifting to integrated software solutions picked up, Koch (2006) observed that ERP vanquished the old stand-alone computer systems in 1990s and replaced them with a single unified system, which has since become flexible enough that users can install some modules that are relevant to their business without buying the whole package. Most large organizations in the developed world have adopted ERP software, whereas the smaller organizations have started to follow their lead (Everdingen, Hiilegersberg & Waarts, 2000). The dynamism of business needs coupled, advancement in technology and the ever-evolving global business environment have led to innovative development of suitable corporate information systems.

Although most of business organizations in the developed world easily adopt new technological innovations, similar organizations in the developing world face numerous challenges due to constraints related to the nature of available information and communication technology (ICT) infrastructure. Additionally, the situation in the developing world is worsened by lack of investment in business research and development.

In Kenya, the manufacturing sector contributes largely to the country's economic development in terms of total output, export earnings and employment creation. According to the survey of 2009, it was found that there was need for the government to formulate viable strategies that laid emphasis on technological innovations, quality of labor force, research and development, and full utilization of government incentives (RoK, 2009). According to KAM (2006), the manufacturers needed to address their internal weaknesses concerning the inefficiencies that emanated from the use of old technology. Due to the outstanding contribution of the sector to the country's economy, coupled with the government's support for development of technological innovations, the new study focused on issues affecting the adoption of ERP system.

The Kenya Association of Manufacturers (KAM) is the premier representative organization for the manufacturing industries in Kenya because its total membership accounts to about a third of all registered manufacturing enterprises in the country. The KAM membership comprises of small, medium, and large-sized enterprises (KAM, 2009). KAM is a membership organization which provides leadership and services aimed at enhancing the development of the Kenya's manufacturing sector. Most of the firms are quite small and have less than 50 employees (KAM, 2006). The challenges facing the manufacturing sector of Kenya included low levels of productivity and the high cost of production (RoK, 2009). A survey carried out on the Kenya's manufacturing sector found that the majority of manufacturers were still using old and inefficient technology which was incapable of achieving the desired efficiency levels (KAM, 2006)

According to Huang and Palvia (2001), the ERP system adopted in North America, Europe and Asia amounted to 66 percent, 22 percent and 9 percent respectively of the Enterprise Resource Planning (ERP) software that had been adopted globally. Additionally, the study indicated that the level of ERP software adopted in the rest of the world, namely; Africa and South America was equivalent to only 3 percent. The ERP adoption disparities between the developed and the developing countries were attributed to factors that hindered the ERP adoption.

The innovation's rate of adoption depends on how organizations perceive the innovation's attributes, the nature of communication channels that diffuse the innovation, the social system, and the extent of agents' promotion efforts in diffusing the innovation (Rogers, 1995). The innovations that have software component only have relatively lower degree of observability and thus a slower rate of adoption. Innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability, and complexity are adopted more rapidly than other innovations (Rogers, 1995). New innovations that are simpler to understand are adopted more rapidly than innovations that require the adopter to acquire new expertise. The easier it is for an organization to observe the results of an innovation, the greater the likelihood to adopt it. It is therefore theoretically evident that the attributes of an innovation and the business environment have influence on adoption.

Kwon's *et al*. (1987) study on organizational innovation model identified five major contextual factors that impact on both business processes and products that are associated with Information Technology (IT). These factors include; user community characteristics (job tenure, education, resistance to change), organization characteristics (specialization, centralization, formalization), technology characteristics, business function characteristics (task uncertainty, autonomy, responsibility of the person performing the task, task variety) and the organizational environment characteristics (uncertainty, inter-organizational dependence). Buonanno *et al* (2005), in a study whose focus was to investigate the ERP system adoption by the small to medium-sized enterprises (SMEs) and large companies aimed at determining the extent to which the two composite variables, namely, business complexity and planned organizational change affected the adoption. The business complexity comprised of company size, market area, membership to associations, presence of branch offices, level of diversification and the degree of functional extension whereas planned organizational change comprised of the Venkatraman's five levels of transformation, namely, local automation of existing procedures, internal integration of existing business processes, business process reengineering, business network redesign and redefinition of company boundaries through the creation of inter-organizational relationships. In the Buonanno *et al's* (2005) study, the indicators of business complexity composite factor were measured qualitatively whereas the planned change factor was measured through a question that suggested the Venkatraman's five levels of planned anticipated change.

From the foregoing literature, composite variables were constituted in accordance to the indicators that had been found to influence adoption of technological innovations. The first composite factor, namely; organization factor, comprised of; company size, market scope, nature of the organization's ICT resources, internal enterprise's culture, and membership to associations, as observed by Koh *et al* (2006), Buonanno *et al* (2005), Rogers (1995), and Kwons *et al*. (1987). Secondly, the planned change was constituted as a composite factor which indicated the anticipated change as a consequence of adopting the ERP technological innovation as reflected by Buonanno *et al* (2005). Business environment was considered the third composite factor that comprises of; ICT regulations, ICT policy stability, Business competition, opportunity cost, competing brands of similar software, local expertise cost, and economic block environment. The new study identified the perceived attributes of ERP as the third composite factor that comprises of; relative advantage, compatibility, customizability, triability, observability. The relative advantage refers to the ERP's benefits over other software, which may include; product uniqueness, vendor effort (extent of agents' promotion efforts), marketing support (nature of communication channels diffusing the innovation), strategic nature, rational cost, nature of software licenses as explained by Rogers (1995) and Kwon's *et al*. (1987).

The variables were represented as shown in figure 1 below;

Figure 1: Conceptual Framework

Independent Variables
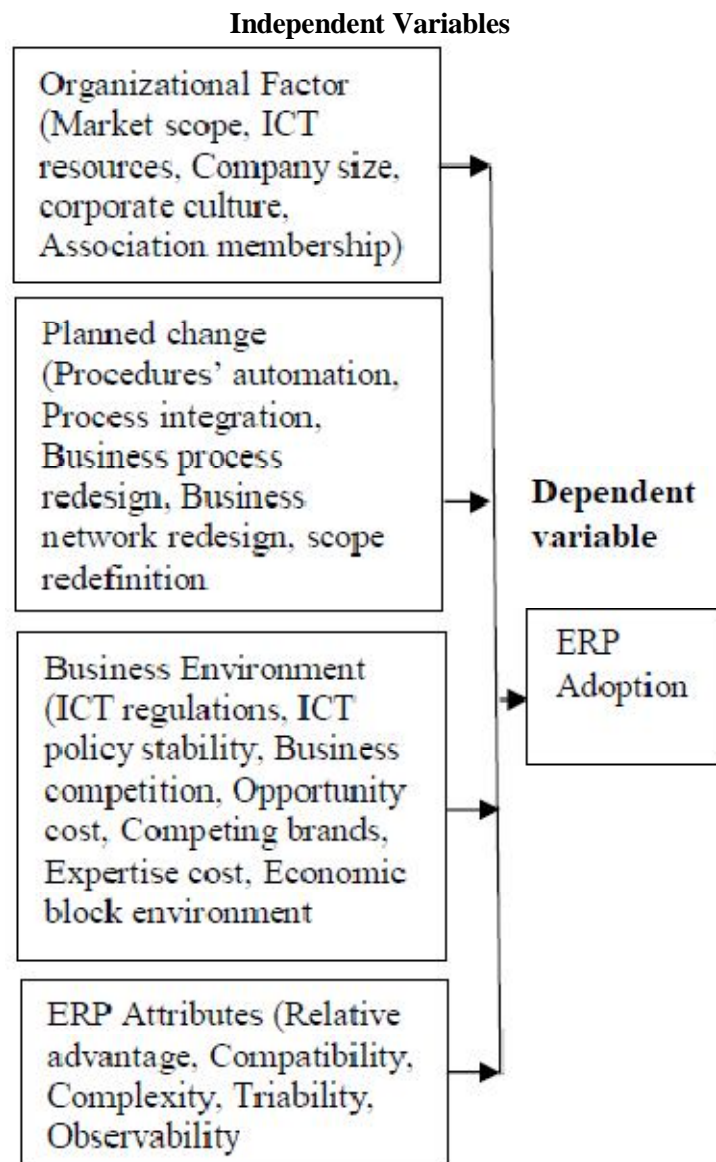
The study tested the following null hypotheses:

H_{o1}: There is no significant relationship between the Organizational Factors and ERP adoption in the manufacturing sector of Kenya.

H_{o2}: There is no significant relationship between planned change and ERP adoption in the manufacturing sector of Kenya.

H_{o3}: There is no significant relationship between business environment and ERP adoption in the manufacturing sector of Kenya.

H_{o4}: There is no significant relationship between ERP attributes and ERP adoption in the manufacturing sector of Kenya.

2. Methodology

The cross-sectional descriptive research design was used to explain the adoption of ERP systems by the KAM members that operate within the Nairobi Metropolitan in Kenya. The research design is suitable in describing the characteristics of a particular individual, or a group of individuals, in a case where the researcher does not have control over the variables (Kothari, 2006). The cross-sectional design allows researchers to make statistical inferences to broader populations and permits the generalizations of the findings to real-life situations, thus increasing the external validity of the study (Chava and Nachmias, 2004). According to Mugenda (2008), descriptive study is used to identify disparities within a community and the type of interventions that a researcher could design and implement to reduce such disparities.

The sample was drawn by selecting a third of companies in each of the 14 sectors of Kenya Association of Manufacturers (KAM). The proportional stratified random sampling technique was used to construct a sample of 141 companies out of the KAM's population of 417 members which operate business within the Nairobi Metropolitan. The sample was equivalent to 33.8 percent of the target population, as shown in Table 1. According to Gay's (1981) observation (as cited by Mugenda & Mugenda, 2003), a sample size which is equivalent to 10 percent of the accessible population is enough for descriptive studies.

Table 1: Sample Size

SECTOR	MEMBERS	SAMPLE	%
Building, Mining and Construction	11	4	36.4
Chemical and Allied	49	16	32.7
Consultancy	29	10	34.5
Energy, Electrical and Electronics	31	10	32.2
Food and Beverage	79	26	32.9
Leather and Footwear	8	3	37.5
Metal and Allied	34	11	32.4
Motor Vehicle and Accessories	19	6	31.6
Paper and Board	50	17	34.0
Pharmaceuticals and Medical Equipment	15	5	33.3
Plastic and Rubber	48	16	33.3
Services	19	6	31.6
Textiles and Apparels	25	8	32.0
Timber, Wood and Furniture	10	3	30.0
Total	417	141	33.8

In addition to the above, a sample of 17 ERP-vendor companies was drawn using the snowball sampling technique for purpose of clarifying the issues related to the supply of ERP software in the Kenya's software industry.

The reliability in this study was ensured by using the Cronbach's alpha coefficient of internal consistency because it provides a unique quantitative estimate of the internal consistency of a scale. The reliability analysis yielded Cronbach's alpha coefficient of 0.71 which compared well with the recommended minimum level of 0.70 which is considered to be acceptable in most social science research situations (Nichols, 1999).

For purpose of this study, construct validity was achieved by ensuring that the relationships between the operationalized variables were in accordance to the represented theoretical constructs, as discussed in the literature review. Prior to the actual data collection, the questionnaire was piloted on eleven companies. The pilot data was not used in the final data analysis. After the necessary modifications were made on the questionnaire, the tool was then used in the collection of primary data. In addition to the above, convergence validity of variables was ensured by carrying out factor analysis prior to regression analysis. According to Dancey and Reidy (2004), factor analysis allows researchers to discover the factorial validity of the questions that make up each construct.

The logit model was used to examine the extent to which each of the factors affected ERP adoption. The regressand (adoption) was a binary variable in the sense that it took the value 1, if a company had adopted ERP software or 0, if otherwise. A company would be considered to have adopted ERP software if it had successfully implemented at least two ERP software modules, or not adopted, if otherwise. Factor analysis (Principal Component's Analysis) was used to reduce the large set of variables into a manageable set that could be fitted into the logit model. According to Dancy and Reidy (2004), the factor analysis is typically used where researchers believe there is a smaller set of factors that cause or in some way influence the observed variables.

When, the dependent variable (i.e adoption), Y =1, meaning that the company had adopted ERP software, then:

$P_i = E(Y=1|X_i) = \beta_0 + \beta_1 X_1 + \ldots + \beta_n X_n$　　(1)

Where:

i. β_0 is a constant
ii. $\beta_1 \ldots \beta_n$, are regression coefficients
iii. $X_1 \ldots X_n$, are the independent variables,
iv. P_i is the probability of adoption.

Since the probability of adopting ERP software is P_i , then the probability of not adopting is $(1- P_i) = 1/(1+e^{zi})$, hence the ratio of the probability that a company will adopt ERP software to the probability that it will not adopt the ERP is as follows :

$P_i/_{(1- Pi)} = (1+e^{zi})/(1+e^{-zi}) = e^{zi}$ ………………(2)
Therefore:
The natural logarithm of [ii] is:
$L_i = \ln(P_i/_{(1- Pi)}) = Z_i$
　　　　　　　$= \beta_0 + \beta_1 X_1 + \ldots + \beta_n X_n$

The estimated equation was:

$L_i = \beta_0 + \beta_i X_i + \mu,$ where *i* is an integer and that $1 <= i <= n$ and μ is the error value.
β_0=constant,　　X_1= Organizational Factors, X_2= Anticipated change, X_3= Business environment, and X_4= ERP attributes.

3. Results and Discussions

Out of the 141 KAM companies which were sampled, 51 companies responded hence the response rate was 36.2 percent (Refer appendix B). The response rate was higher than that of Buonanno et al. (2005), in which 370 out of 2, 000 companies that responded, thus explaining a response rate of 18.5%. According to Krosnick's (1999) study (as cited in McBurney and White, 2007), lower response rates do not necessarily translate into less accurate results. The age of the majority (90.2 %) companies ranged between 1 and 60 years, hence the mean age value of the companies was 32.85 years. The relationship between adoption and company age yielded a Pearson's (R) coefficient of 0.639 at 0.01-level of significance. These findings confirmed the conclusion of Padaria et al. (2009) in which it was established that there existed a positive hypothetical relationship between an adopter's age and technological adoption. This can be attributed to the greater amount of resources and mature experience in information technology attributed to such companies.

The findings indicated that 68.6% of the 51 companies were found to be of local origin (that is, indigenous), out of which only 23.5% were found to be adopters of ERP software. The multinational companies accounted for 31.4% of all the companies, in which the ERP adopters were found to be equivalent to 15.7%. It therefore meant that the ERP adoption levels among the local companies were slightly higher than among the multinational companies.

This is explained by the fact that some of the multinational companies originated from developing countries which face dismal adoption of technological innovations.

The research findings revealed that 39.2 of the sample had adopted the ERP for a period of over 20 years. The first cases of ERP adoption occurred between the years 1986 and 1990 when 5% of the adopters took up the technological innovation. Between the years 1991 and 1995, the adoption remained at 5%. The period 1986 to 1995, in which the adoption remained constant at 5%, was equivalent to the first adopter category, namely the innovators category. In the subsequent periods 1996-2000, 2001-2005, and 2006-2010, the adoption went up to 20%, 30%, and 40% respectively. Hence the adoption period 1996 to 2010 was equivalent to the early adopters' category (See Figure 2).

Figure 2: ERP Adoption Trend in Kenya
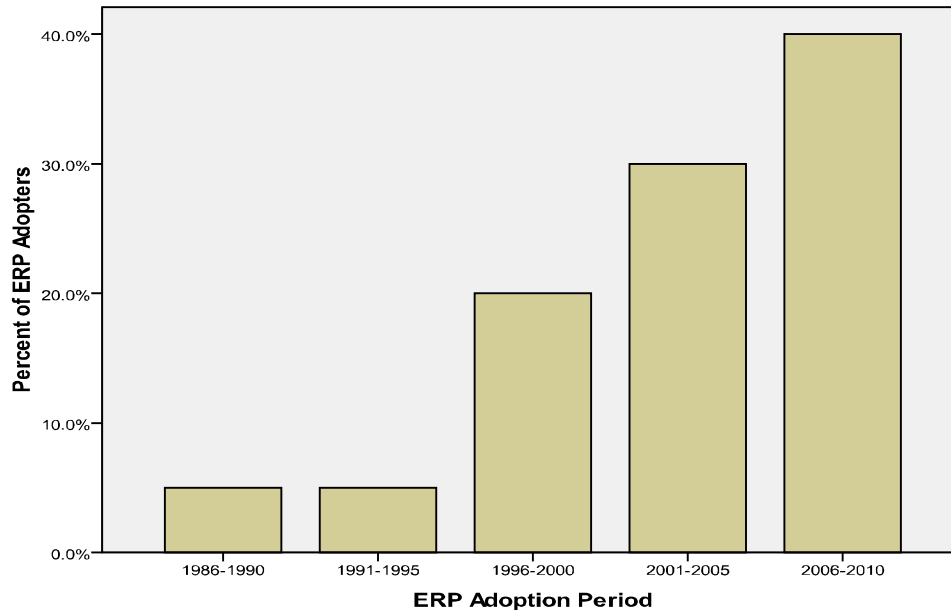
Prior to the regression analysis, factor analysis was carried out on the 30 independent variable indicators to ensure convergent validity. According to Dancey and Reidy (2004), the aim of factor analysis is to account for a large number of variable indicators, in terms of a minimal number of primary factors. Firstly, the principal components analysis (PCA) was performed on the 10 independent variable indicators that constituted the organizational composite factor which consequently reduced to 4 variable indicators, namely; annual turnover, corporate culture, total cost of ownership of software, and ICT-in-charge's level. Each of the four variable indicators was selected by considering the independent variable which had the highest loading in the respective component. Each of the 4 variable indicators had Eigen values that were above 1.0, which jointly accounted for a cumulative variance of 66.5% of the organizational composite factor. The organizational composite factor was computed as an average of the 4 independent indicators. Further to this, multicollinearity test was carried out on the 4 independent indicators against the organizational composite factor (dependent variable). Absence of multicollinearity was confirmed since the tolerance values were greater than 0.1 and the variance inflation factor (VIF) values were less than 10 (See Table 2).

Table 2: Factor Analysis Results

Composite Factor	Variable	Cum%	Collinearlity statistics	
			Tol	VIF
Organizational Factors	Annual turnover	26.4	0.91	1.10
	Corporate culture	41.7	0.98	1.02
	Total software cost	55.0	0.91	1.10
	ICT-in-charge level	66.5	0.92	1.09
Organization Change	Business process redesign	45.4	0.93	1.08
	Business network	68.5	0.93	1.08
Business Environment	ICT regulation	33.8	0.97	1.03
	Information systems expertise	50.8	0.99	1.01
	Software brands	65.6	0.98	1.02
ERP Attributes	ERP Compatible	48.8	1.00	1.00
	Vendor efforts	64.9	1.00	1.00
Key: Cum – Cumulative variance, Tol - Tolerance, VIF-Variance Inflation Factor)				

Secondly, the PCA factor analysis reduced the 5 variable indicators of the planned change composite factor to 2, namely; business process redesign (BPR) and business network (that is, collaborations). The two variables jointly accounted for a cumulative variance of 68.5%. The planned change composite factor was computed as the average of the 2 indicators. The study established that there was no multicollinearity among the 2 independent variable indicators because the tolerance values were higher than 0.1 and the VIF values were less than 10.

Thirdly, the seven (7) variables of the business environment composite factor were reduced to 3 variable indicators, that is; ICT regulations, information systems expertise, and competing software brands which had a joint cumulative variance of 62.9%. The business environment composite factor was calculated as the average of the 3 variable indicators. Further analysis proved that there was no multicollinearity among the 3 indicators since tolerance values were greater than 0.1 whereas the VIF values were less than 10.

Fourthly, the factor analysis on ERP attributes' composite factor reduced the 8 variable indicators to 2 variable indicators, namely; ERP compatibility and vendor promotional efforts. These two ERP indicators jointly accounted for a cumulative variance of 62.9% in the composite factor. The ERP attributes' composite factor was worked out as the average of the 2 independent variable indicators. The study found out that there was no multicollinearity among the 2 independent variable indicators because the tolerance values was higher than 0.1 while the VIF values were less than 10.

According to Polson's *et al*. (1992) study (as cited by Karki and Bauer, 2004), the binary logit regression model is considered appropriate in a situation where the dependent variable has only two values, 1 if the event occurs, or 0 if otherwise. The logit model is flexible in a situation where the independent variables are either of interval or categorical types (Karki and Bauer, 2004). In accordance to the above, the logit model was applied in this study because of the binary nature of ERP adoption.

Logit regression was carried out involving the composite factors, namely; organizational factor, planned change, business environment, and ERP attributes for purpose of testing the significance of their relationship with the ERP adoption in Kenya, as per the hypotheses of the study. The logit regression results indicated that the Chi-square was 27.487 at p=0.000 and that the accuracy of the overall prediction was 86.3%. Additionally, the *-2Log likelihood* and the Nagelkerke (R^2) values were 40.823 and 0.565 respectively.

Table 3: Composite Factors Determining ERP Adoption in Kenya

Composite Factor	Coefficient (ß)	t-value	p-value
Organizational Factors	0.006	3.000	0.011**
Planned anticipated change	1.293	1.776	0.076
Business environment	0.443	0.791	0.429
ERP Attributes'	2.390	1.693	0.091
Constant	-15.871	2.908	0.004

The study established that the Organizational Factors composite factor was a significant determinant (ß=0.006 at p=0.011, and t=3.000) of ERP adoption in Kenya, thus implying that the greater the complexity of a company's business functions, the greater the probability of ERP adoption (Table 3). These findings led to the rejection of the null hypothesis; Ho1: There is no significant relationship between the Organizational Factors and ERP adoption in Kenya. These findings meant that the companies regarded the ERP system as a solution to their Organizational Factors. These findings contradicted those of Buonanno et al. (2005), in which Organizational Factors was found to be a weak predictor of ERP adoption.

In addition to these findings, the planned change composite was found to be positively and insignificantly (at p=0.076 and t=1.776) related to the ERP adoption in Kenya (See Table 3). These findings implied that planned change was a weak predictor of ERP adoption. The qualitative data that was collected from 17 ERP-vendor companies revealed that there was poor product knowledge about ERP software among the current and potential ERP users. These findings led to the acceptance of the null hypothesis; Ho2: There is no significant relationship between organization change and ERP adoption in Kenya. This was in contradiction to the study of Buonanno et al. (2005), that the extent of planned change significantly affected ERP adoption (Pearson's R=0.306 at 0.01-level of significance).

The study revealed that the business environment composite factor was positively, though insignificantly related (at p=0.429, and t=0.791) to the ERP adoption in Kenya; hence it was a weak predictor of ERP adoption (Table 3). Hence these results led to the acceptance of the null hypothesis; Ho3: There is no significant relationship between business environment and ERP adoption in Kenya. This is a clear indication that the business environment in which the companies were operating in Kenya was not significantly influencing the ERP's adoption-decision making process.

The ERP attributes' composite factor was found be positively and insignificantly related (ß=2.390 at p=0.091 and t=1.693) to the ERP adoption in Kenya (Table 3). This led to the acceptance of the null hypothesis; Ho4: There is no significant relationship between ERP attributes and ERP adoption in Kenya. It therefore meant that the ERP attributes' composite factor was a weaker predictor of ERP; hence the companies were not significantly influenced by the ERP attributes to adopt the ERP software in Kenya. These results contradicted the theoretical expectations advanced by Rogers (1995), that the adoption of an innovation is determined by its perceived attributes. This contradiction was associated with the poor knowledge of ERP software among the adopters.

Based on the findings of this study, it was recommended that the ERP vendors should;

i. Develop all-inclusive ERP technological solutions that cater for all sizes of organizations. The study had found that most of the current ERP technological solutions were tailored to support the middle and large-sized organizations.

ii. Disseminate the product knowledge about ERP system among both the current and potential corporate adopters.

The ERP adoption was found to be minimal (39.2%) and at the early stages in Kenya, The study established that the organizational factor was an important determinant of ERP adoption, whereas anticipated change, business environment, and ERP attributes' factors were weak predictors of ERP adoption in the manufacturing sector of Nairobi Metropolitan in Kenya.

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