

How Technological Innovation is Influencing Performance of the Cement Manufacturing Firms in Kenya

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Abstract

The business environment of cement manufacturing firms in Kenya has been very volatile. The uncertainties are largely occasioned by socio-economic reforms, regulatory anxieties, technological advancements, competition and effects of globalization. As a result, cement manufacturing firms are expected to be adaptive and responsive to the changing environment by leveraging on technology. However, there has been slow uptake of technology by cement manufacturing firms in Kenya, which has occasioned low production capacity. The reduced production capacity is attributable to operational inefficiencies that result to unprecedented sustainability challenges and non-competitiveness. This study aimed to assess the role of technological innovation in influencing the performance of cement manufacturing firms in Kenya. It utilized the diffusion of innovation theory and Schumpeter's theory of innovation. The study population comprised the nine cement producing companies in Kenya. A cross-sectional survey research design was adopted, and the units of observation were the 79 department heads. A closed-ended questionnaire was used to collect data. Pretesting of the instruments was done to check the content, construct validity, and reliability. The mean, standard deviation, Pearson correlation and linear regression analysis were used to analyze the data. The findings revealed a positive relationship between technological innovation and performance of Kenyan cement manufacturers. Regression results confirmed that technological innovation significantly predicts approximately twenty-five per cent of the variation in the performance of Kenya's cement manufacturing firms. The study concluded that technological innovation is significant in influencing the success of cement manufacturing firms. It recommended adopting an integrated manufacturing management information system, implementing continuous improvement of processes, enhancing collaborations in the development of industry-specific technology, innovative technology in the production processes, and training staff on technical skills. The findings are valuable in informing production practices in the manufacturing industry.

Keywords: *Technological innovation, the performance of cement firms, cement manufacturing firms, cement*

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1.0 Introduction

Tornatzky, Fleischer and Chakrabarti (2014), and Kijkasiwat and Phuensane (2019) described technological innovation as a new invention developed by technological experts. In this study, technological innovation refers to the application of new technologies developed via research and technical competence, aimed to improve production methods within cement manufacturing enterprises. Technological innovation has been described by Valacich and Schneider (2012) as the implementation of tools like Enterprise Resource Planning (ERP) systems that provide features that support and enhance the production processes. Valacich and Schneider (2012) pointed out that such methods and technologies should improve company activities by automating operational tasks.

Technological innovation is an essential cofactor in a firm's competitiveness (Hermundsdottir & Aspelund, 2021; Zwass, 2013). It is significant to companies looking to gain and compete in the market and expand into new areas. Notably, performance of most firms is heavily reliant on effective operational processes, which are responsible for rising expenditures that result from lack of internal efficiency-enhancing technology (Munyoroku, 2014; Cahn et al., 2019).

Globally, profitability, which is a measure of both proficiency and adequacy of associated activities, is the principal financial measure used to determine the performance of an organization (Atalay, Anafarta & Sarvan, 2013). This same indicator was adopted in this study to address the performance of cement manufacturing companies. From a global arena, the most successful companies in cement manufacturing industries operating in the European countries have adopted state of the art technology (Cahn et al., 2019). The

move has been attributed to technological innovation efficiency in the performance of these firms. Firms that reported less technological innovation efficiency, for example, in Spain, were noted to have made an unrealistic projection, and only a few managed to survive (Claudio, Teresa & Cristina, 2013).

In Africa, cement, concrete and construction business have been growing rapidly. Nigeria and South Africa are currently the largest cement producers in Africa. They produce 45,000 and 20,000 metric tons per annum, respectively. Ethiopia, Kenya and Tanzania follow at a distance, at 16000, 13,000 and 10,000 metric tons per annum, respectively (Construction Review Online, 2021; Statista, 2021). The sale of cement is expected to proliferate until 2050 (Construction Review Online, 2021; Schmidt et al., 2018). The main drawback in the cement manufacturing industry in Africa has been the use of old technology, high energy costs, which have raised production cost and subsequently lowered imports; the recent effect of the Covid-19 pandemic, among others.

The performance of Kenyan manufacturing firms was the subject of this research. Kenya has nine cement manufacturing enterprises; namely, Bamburi Cement, Athi River Mining Cement, East African Portland Cement, Mombasa Cement, National Cement, Savannah Cement Limited, RAI Cement Limited Simba Cement, and ARM Cement Limited (Chesaro, 2013). In the recent past, these firms have been struggling to survive. For example, Athi River Mining Company's profit before tax went down from KES 2 billion in 2014 to a loss of KES 3.5 billion in 2015 (Kenya Association of Manufacturers, 2016). Other cement producers such as Bamburi Cement, East African Portland Cement, Mombasa Cement, National

Cement, Savannah Cement Limited, RAI Cement Limited, Simba Cement, and ARM Cement Limited have also faced operational and sustainability challenges owing to inflated fuel prices, which have harmed the production efficiency and cost. Consequently, inefficiency has dwindled their profitability, hence affecting their overall performance.

Statement of the problem

The business environment for cement manufacturing firms in Kenya has been very volatile. The uncertainties are largely occasioned by the socio-economic reforms, regulatory anxieties, technological advancements, competition and effects of globalization (Chesaro, 2013; Kenya Association of Manufacturers, 2016). Therefore, the cement manufacturing firms are expected to be adaptive and responsive to the changing environment by leveraging on technology. However, cement manufacturing firms have slow uptake of technology in Kenya, thereby occasioning a low production capacity due to operational inefficiency, and subsequent unprecedented sustainability challenges and non-competitiveness (Kenya Association of Manufacturers, 2016). Notably, there has been growing interest in the cement manufacturing industry in Kenya. New players, captivated by the growing demand for cement, are coming in after a long period of dormancy. The main drawback has been leveraging technological innovation in their production processes. This drawback has occasioned low production and high manufacturing costs. The low production could largely be linked to lack of technological innovativeness in the production process. If the latter is adopted, these companies would not only scale down the cost of manufacturing at both the firm and industry level, but also increase turnover and bottom line. Prior studies have not looked at

the effect of technical innovation in determining the success of Kenyan cement manufacturing companies; thus the gap that this study sought to fill.

Purpose of the study

This research aimed to determine how technological innovation influences the performance of cement manufacturing firms in Kenya.

Hypothesis of the study

H₀: Technological innovation does not influence the performance of cement manufacturing firms in Kenya.

Literature review

Rogers' diffusion of innovation theory of 1962 informed this research. The concept explains how, why, and when new ideas propagate. Diffusion, according to Rogers, is the process through which advancement is spread among members of a social system over time. The theory explains why, and how quickly new technologies are applied. Diffusion, according to Rogers, is the process through which innovation is disseminated over time among members of a social structure. He noted that for technologies to be sustainable, they must be broadly used (Rogers, 1985). Hence, the rate at which technological innovation is implemented is critical for organizational growth and development.

Researchers have looked at the impact of technological advancements on business performance in the past. However, no studies on the influence of technological advances on the performance of Kenyan cement companies have been conducted. Laudio, Teresa, and Cristina (2013) and Alonso et al. (2020) investigated the influence of advances in technological efficiency on business performance in Spanish manufacturing

enterprises between 1990 and 2005. They observed that employing innovation without accounting for the time it takes to create them might exaggerate their influence on business performance. The findings revealed that Spanish manufacturing sector had few efficient firms, implying that the manufacturing process should be improved by enhancing technology. The significance of quantifying technical innovation efficiency as predictors of business performance, rather than just counting innovation inputs or outputs, was also demonstrated in this study. As opposed to earlier studies that employed a panel data collection method, the current study has used a cross-sectional data set.

“Innovation is a fundamental source of long-run competitiveness since it prompts production and operational efficiency, enhances a firm's survival, enables rapid development of firms, and increases the bottom line.”

Odhiambo (2014) and Maina (2016) assessed Standard Chartered Bank's innovation efforts in Kenya, and reported widespread adoption of technology innovation tactics that have been crucial in lowering operation costs and increasing customer satisfaction. Although the adoption of technological innovation in the banking industry was evident, the equivalent application of the results in the cement manufacturing firms was a glaring gap.

Didier and Olsson (2014) investigated the relevance of an inclusive approach in service innovation through a study of micro-insurance enterprises. They first identified the internal and external drivers of innovation before highlighting the importance of process modifications aided by technology in achieving service quality. The findings made it possible to define the primary advantage of technological innovation in the production process.

2.0 Methodology

This study took a quantitative approach and employed a cross-sectional descriptive survey research design. Data was collected from all the nine cement production enterprises in Kenya. Units of observation were the 79 heads of the department. Primary data was collected through closed-ended questionnaires which had been pre-tested for content and construct validity (Mohajan, 2017). Reliability was calculated using Cronbach's Alpha coefficient. Descriptive statistics that includes frequencies, percentages and means were computed, while inferential analysis (Pearson correlation and linear regression) were used to measure the variables. Tables were used to present the data.

3.0 Results and discussion

The reliability of the data was determined using the Cronbach's Alpha coefficient. The results are shown in Table 1.

Table 1

Reliability Result

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.954	.952	43

As indicated in Table 1, Cronbach's alpha coefficient of .954 was noted. This indicated a 95.4% reliability level. A Cronbach alpha

coefficient of 0.7 is usually considered adequate (Sekaran & Bougie, 2010); Mahajan, 2016; Mohajan, 2017).

Response rate

Out of the 79 administered questionnaires, 64 were returned. Two questionnaires had incomplete answers and were therefore not excluded from the analysis. This resulted in 62 valid questionnaires, which indicated a 78% response rate. The response rate of 78% was regarded as significant and reliable in the analysis. According to Lewis, Thornhill and Saunders (2009), a more than 70% response rate is adequate. The high response rate in this study was attributed to good data administration techniques.

performance of Kenyan cement businesses. Participants were asked to score their agreement on statements based on various aspects of the study's variables using a 5-level Likert scale. The performance of cement manufacturing enterprises in Kenya was the dependent variable in the research. Because the subject of a company's performance is typically seen as very sensitive and secretive, few firms were willing to share their financial information. As a result, actual information regarding the performance of the cement manufacturing firms was derived from items developed to capture corporate performance based on the views of the heads of departments. Table 2 summarizes these findings.

Relationship of technological innovation and performance of Kenyan cement manufacturing companies

The purpose of this study was to examine how technical innovation influence the

Table 2

Descriptive Statistics on Performance of Cement Manufacturing Firms in Kenya

Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
N= 62						
Because of strategic advancements, our company's sales volumes have risen.	2(3.2%)	2(3.2%)	2(3.2%)	22(35.5%)	34(54.8%)	4.35
Our personnel have all of the required abilities to increase production as a result of involvement with strategic innovations	1(1.6%)	1(1.6%)	9(14.5%)	23(37.1%)	28(45.2%)	4.23

Our company's manufacturing costs have decreased dramatically due to strategic improvements	1(1.6%)	3(4.8%)	5(8.1%)	26(41.9%)	27(43.5%)	4.21
Through technological innovation, our firm's productive capacity has improved.	2(3.2%)	1(1.6%)	13(21%)	24(38.7%)	22(35.5%)	4.02
Aggregate mean score						4.20

Table 2 shows that most respondents agreed with the numerous statements that aimed at determining the performance of Kenyan cement production enterprises, with a mean aggregate score of 4.20. The top three statements (the ones with the highest mean scores) in describing the performance of cement manufacturing companies were: because of strategic advancements, our company's sales volumes have risen (mean, 4.35); our personnel have all of the required abilities to increase production as a result of involvement with strategic innovations (mean, 4.23); and our company's manufacturing costs have decreased dramatically due to strategic improvements (mean, 4.21). These findings show that sale volumes, customer base, and profitability are all factors that determine the performance of Kenyan cement manufacturing companies. The performance is also dependent on operational efficiency, reduction of cost of production and the presence of skills that

enhance productivity. These findings underscore the essence of innovation in fostering high performance in cement manufacturing firms. According to Cahn (2019), innovation is a fundamental source of long-run competitiveness since it prompts production and operational efficiency, enhances a firm's survival, enables rapid development of firms, and increases the bottom line.

This study aimed to see how technological innovation influences the performance of Kenyan cement manufacturing companies. Some of the aspects that were assessed in the technological innovation construct included integrated manufacturing management information system; inter-organizational processes and collaborations; innovative technology in the production processes; automation of systems and routine tasks; and training of staff on technical skills and generation of online reports. The descriptive results are shown in Table 3.

Table 3

Descriptive Statistics of Technological Innovation and Performance of the Cement Manufacturing Firms in Kenya

Statements N= 62	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Our firm has acquired integrated manufacturing management information system	4(6.5%)	4(6.5%)	16(25.8%)	24(38.7%)	12(19.4%)	3.71
Our company values collaboration and interorganizational procedures	2(3.2%)	8(12.9%)	16(25.8%)	24(38.7%)	12(19.4%)	3.58

Our company has put a lot of money into new technology	2(3.2%)	8(12.9%)	22(35.5%)	16(25.8%)	14(22.6%)	3.52
Our company has engaged in technical skills training for its employees so that they can embrace technological progress.	2(3.2%)	6(9.7%)	22(35.5%)	22(35.5%)	10(16.1%)	3.52
Our firm has adopted new innovative technology	2(3.2%)	10(16.1%)	18(29.0%)	20(32.3%)	12(19.4%)	3.48
Our firm has automated its systems and routine tasks	4(6.5%)	6(9.7%)	24(38.7%)	20(32.3%)	8(12.9%)	3.35
Our firm is able generate online reports	4(6.5%)	12(19.4%)	22(35.5%)	12(19.4%)	12(19.4%)	3.26
Aggregate mean score						3.49

Table 3 shows that most respondents (43, 69.77 %) agreed with the sentiments aimed at assessing the impact of technical innovation on the performance of Kenyan cement manufacturing enterprises, with an aggregate mean score was 3.49. In characterizing the influence of technological innovation on performance, participants agreed with the top four statements (the ones with the highest mean scores); that our firm has acquired an integrated manufacturing management information system (mean, 3.71); our company values collaboration and inter-organizational procedures (mean, 3.58); our firm has heavily invested in innovative technology (mean, 3.52); and our company has engaged in technical skills training for its employees so that they can embrace technological progress (mean, 3.52). The mean score of two assertions with the lowest mean score was: our business's systems and regular jobs have been automated (mean, 3.35); and our firm can provide online reports (mean, 3.26).

To corroborate these findings, participants were asked to identify the extent to which they believe technological innovation affected their firm's success. Majority of the

respondents, 33 (53 %), indicated to a significant degree; while 29 (47%) said to a moderate extent.

The results indicate four critical components of technical innovation that are important in driving the success of Kenyan cement manufacturers. These include an integrated manufacturing management information system; inter-organizational procedures and partnerships; new manufacturing technologies; and employee technical skill training. The findings also highlight the necessity for cement manufacturing companies to automate processes and begin the production of online reports to cut costs.

The findings support those of Zwass (2013) and Hermundsdottir and Aspelund (2021), who linked technological innovation to new products, automation of regular jobs, and the adoption of new systems. Notably, organizations' performance is heavily reliant on effective operational procedures, which result from increased investments in technology that improve internal efficiency (Munyoroku, 2014).

Test of Hypothesis

The study used an inferential statistical analysis to determine the association between the variables. This helped to test the null hypothesis, H0: technical innovation does not influence the performance of Kenyan cement manufacturing enterprises. To test this

hypothesis, a univariate Pearson correlation between the independent variable X1 (technological innovation) and the dependent variable Y (manufacturing company performance) was used. Table 4 contains the results.

Table 4

Univariate linear correlations between technological innovation and firm performance

Model		Y	X1
Y	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	62	
X1	Pearson Correlation	.499**	1
	Sig. (2-tailed)	.000	
	N	62	62

** . Correlation is significant at the 0.01 level (2-tailed).

Results indicate $r = .499^{**}$ and a P value of .000. These findings show statistical proof that technical innovation has a positive association with the performance of Kenyan cement manufacturing businesses. They are consistent with those of Tajuddin, Iberahim, and Ismail (2015) who demonstrated that technical innovation had a positive and

significant influence on the production of manufacturing firms. The impact of technological innovation on the performance of manufacturing enterprises in Kenya was further investigated using linear regression analysis. Tables 5, 6, and 7 present the findings.

Table 5

Technological Innovations and firms performance: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.499 ^a	.249	.236	.54334	.249	19.849	1	60	.000	2.083

a. Predictors: (Constant), X1

b. Dependent Variable: Y

Table 5 shows that technical innovation is responsible for 24.9 per cent (R square value =.249) of the overall variance in the performance of Kenyan cement manufacturing enterprises. These findings support the earlier (Table 4) findings that there is a positive and significant relationship

between technical innovations and cement manufacturing enterprise performance. Durbin-Watson's value of 2.083 in model summary Table 5 is higher than 1; hence there was no autocorrelation problem in the model. The significance of the model was also ascertained, as shown in Table 6.

Table 6

Technological Innovations and Firms Performance: ANOVA Summary

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	5.860	1	5.860	19.849	.000 ^b
1	Residual	17.713	60	.295		
	Total	23.572	61			

a. Dependent Variable: Y

b. Predictors: (Constant), X1

These results indicate statistically significant findings. P-value is less than 0.05 level of significance (F (1, 60) = 19.849, $P < .000$.); hence the influence of technological innovation on the performance of cement manufacturing firms is statistically significant. This led to the rejection of the null hypothesis (H0), and concluded that technological innovation was statistically significant in influencing the performance of cement manufacturing firms in Kenya. This study supports the importance of technological innovation in forecasting the performance of Kenyan cement companies.

However, the findings differ from Muita (2013), who found out that customers' requirements are the most critical indicators of a firm's performance. The inconsistency in the results was attributed to differences in the industry from the time Muita's study was done in the telecommunication industry.

The study further computed the regression weights to determine the regression coefficients associated with technological innovation. The regression weight results are shown in Table 7.

Table 7

Technological Innovations and Firms Performance: Regression Weights

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error				Tolerance	VIF
1	(Constant)	2.857	.291				
	X1	.361	.081	.499	4.455	.000	1.000 1.000

a. Dependent Variable: Y

Regression coefficients for technological innovation in the model show a VIF value of 1.000. This indicates that there was no multicollinearity problem in the two variables. This indicates that the regression model was fit for data analysis and interpretations. In coming up with the regression weight, the unstandardized B-coefficients, rather than the beta coefficients, were used because all items defining the technological innovation predictor (X1) had similar Likert scales. Furthermore, the constant value was significant.

4.0 Conclusion

The findings of this study show that technical innovation has a positive and significant impact on the success of Kenyan cement manufacturing enterprises. The study highlighted four key components of technological innovation that are important in driving the performance of Kenyan cement manufacturers. These were: an integrated manufacturing management information system, inter- processes and partnerships, cutting-edge manufacturing technology, and technical skill training for employees.

This study implies that any cement production company that implements technical innovation will always see a considerable boost in performance. Consequently, the value of regression weight shown in Table 7 indicated that a good performance will always exist in the cement manufacturing firms at a particular significant minimum ($\beta_0=2.857, P < .000$). This finding highlights the critical need for Kenyan cement production companies to improve their technological advancements, which are outlined in Table 3

5.0 Recommendations

This study discovered that technological innovation has a significant impact on the success of Kenyan cement manufacturing companies. Consequently, cement manufacturing companies in Kenya should adopt an integrated manufacturing management information system in their operations; embrace inter-organizational processes and collaborations; implement innovative technology in the production processes; and develop a deliberate strategy of training and developing their staff on technical skills. There is also need for cement manufacturing firms to automate systems and routine tasks to reduce operating costs. These recommendations implicate budgetary

allocation policies and innovation policies; and further impact on the production processes and methods adopted by the cement manufacturing firms in Kenya and other regional countries.

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