



Exploring the synergy of advanced manufacturing technology, competitive advantage, and organizational resources on performance: a study of large manufacturing companies in Kenya

ABSTRACT

Manufacturing companies invest in Advanced Manufacturing Technology (AMT) to improve their performance and positively contribute to GDP in their Countries. Studies have found that AMT, competitive advantage and organizational resources have a positive and significant relationship with manufacturing performance when considered as independent variables. This study investigated the joint effect of AMT, Competitive Advantage, and Organizational resources on performance of large manufacturing companies in Kenya. The study employed a descriptive cross-sectional survey. A total of 55 large manufacturing companies in Kenya that were members of Kenya Association of Manufacturers formed the population of the study. Multiple regression was used to analyze the collected data. Findings of the study show that AMT, competitive advantage, organizational resources have a very strong relationship to performance of large manufacturing companies in Kenya. Further, the study found that the joint effect of AMT, competitive advantage and organizational resources explained approximately 50% of performance in large manufacturing companies. The study concludes that there is a strong synergy between AMT, competitive advantage and organizational resources which leads to improved performance for manufacturing companies that identify strategic resources they own, adopt and implement AMT properly. The study recommends that manufacturing companies identify appropriate AMT that are in tandem with their manufacturing strategy. The results will particularly assist practitioners

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in identifying appropriate AMT and development of policy and manufacturing strategies in recognizing the effect of synergy between AMT, competitive advantage and organizational resources on performance in manufacturing companies.

INTRODUCTION

Advanced Manufacturing Technology (AMT) continue to enable manufacturing companies develop competitive advantage and create a niche for themselves in their respective markets. Studies show that AMT has a positive and significant relationship with performance. Further, effective implementation of AMT allows manufacturing companies to develop competitive advantage and grow their market share using both cost leadership and differentiation strategies (Musebe, Awino, K'Obonyo & Kitiabi, 2020). Arising from the growth in market share by adopting AMT, manufacturing companies are able to realize improved profitability in their operations (Lim & Rokhim, 2020).

Emanating from the resource-based view (RBV) of strategy, it is instructive that Strategic resources owned by manufacturing companies and deployed in certain ways relative to competitors enable them develop and sustain competitive advantage in their industry. Companies are deemed to have successfully developed competitive advantage in their market when they consistently attain above average return on their investments for a sustained period of time (Behl, Gaur, Pereira, Yadav, & Laker, 2022). According to, Musebe, Awino, K'Obonyo and Kitiabi (2020); Marri, Irani, and Gunasekaran, (2007), AMT on its own does not make manufacturing companies develop and sustain competitive advantage in their operations.

A fit that exists between AMT and other core competencies in manufacturing companies enable them to develop and sustain competitive advantage which in turn improves their organizational performance (Kotha & Swamidass, (2000); Musebe et.al. (2020); Hyneck & Janecek, (2012); Amit and Schoemaker, (1993); Grunert & Hildebrandt, (2004)). Kotha and Orne, (1989), using conceptual models positively linked manufacturing strategy, business strategy, structure, and environment to performance of manufacturing companies

Arising from the finding by Kotha and Orne (1989), decisions involving investment and adoption of manufacturing technologies in production process are considered to be strategic. This emanates from two distinct characteristics associated with these decisions which are, being both long-term and capital intensive. Lack of strategic thinking when making the AMT investment decision contributes to the variance observed between expected and observed improvements in performance (Al-Surmi, Bashiri, & Koliouis, 2022).

The magnitude of improvement observed in performance, when applying AMT in production, determines the effectiveness of the technology used in meeting desired levels of performance. Investing in technology encourages absorptive capacity in manufacturing companies leading them to achieve stability strategies, expansion strategies, retrenchment strategies or a combination of strategies, that form part of their long-term objectives (Ren, 2019). According to Bayus, 1994; Tracey, Vonderembse, and Lim, (1998), a new competitive environment for manufacturing companies has evolved out of the factors associated with globalization, dynamic markets, increasing consumer awareness, manufacturing complexity and business uncertainty. This new competitive environment causes a shift in manufacturing strategies employed by manufacturing companies from employing efficient production systems alone to embracing AMT to offer efficient and flexible transformation of raw materials into finished products to meet particular consumer demands in their markets.

Productivity as a measure of performance in manufacturing companies can be

operationalized using various concepts including; Objective concept or outcome of a process, Scientific and empirically observed concept, measure concept, efficiency concept and as a factor concept. During the industrial era, manufacturing companies used the measurement concept of productivity by practicing mass production to achieve economies of scale (Skinner, 1986). This has changed in the post-industrial era where manufacturing companies anticipate changes in the market and use flexible production systems to meet the current efficiency concept of performance (Tracey, Vonderembse, & Lim, 1998). This study used the efficiency concept by considering both financial and non-financial aspects of performance to operationalize performance.

Researchers define AMT broadly as the application of stand-alone, intermediate or integrated computer systems in the production process with the objective of improving organizational performance. This study conceptualized AMT to include design technologies, Computer aided process planning and Group technology.

According to Dollard and Bakker, (2010); Albrecht, (2012) Organizational resources can be referenced to the experiences of the “upstream” distal, contextual, or system-level aspects of the organizational environment by employees of an organization. This study conceptualized organizational resources as being system sponsored sources of supply and support that can be drawn upon by individuals and groups to help achieve psychological, attitudinal, motivational, behavioral, team, and organizational outcomes (Albrecht, Breidahl, & Marty, 2018).

Davenport (1993); Schoonhoven (1981) and Wheelwright (1978) ascertained that there is a positive relationship between technology, competitive resources and the utilization of organizational resources to performance especially for certain product functionality and cost conditions. Further, AMT provides unique opportunities for manufacturing companies related to product aspects (quality, performance, reliability, conformance, durability, serviceability) and customer needs (Variety, quality, price, functionality, availability). This study investigated the joint effect of AMT, competitive

advantage and organizational resources on performance of large manufacturing companies in Kenya by developing the following hypothesis

H1: There is a significant joint effect of advanced manufacturing technology, competitive advantage and, organizational resources on performance of large manufacturing companies in Kenya.

METHODOLOGY

Arising from the literature review, a conceptual framework was developed to test the relationships between the four study variables. The study employed the positivist research philosophy in collecting and analyzing data while descriptive cross-sectional research design was adopted because of the distinctive features it has, that were important to the study (Crotty, 1998). This was a descriptive cross-sectional study that comprised 55 large manufacturing companies in Kenya and which were members of the Kenya Association of Manufacturers as at December 31st 2018. A self-administering structured questionnaire was used to collect data from the respondents in the 55 manufacturing companies and the Likert scale was used to rate the responses of the collected data. A total of 45 questionnaires were returned by the respondents representing a response rate of 81.8%.

Descriptive statistics was used to determine the relationship between the study variables while regression analysis was used in inferential statistics involving the determination of correlation and multiple linear regression analysis to test the hypothesis that were developed in the study. The results are presented in the next section.

RESULTS AND DISCUSSION

Introduction

Results of the study are presented using both descriptive statistics and regression analysis on the relationship between the four study variables.



Diagnostic Tests

Diagnostic tests were done on the collected data to determine validity of the data and hence allow the results of the study to be generalized in their application. These tests included, reliability test, normality test and multi-collinearity test.

Reliability Test

The study used Cronbach's (α) to determine reliability of the study instrument and adopted Cronbach's (α) values of between 0.58 – 0.97 to be suitable. Cronbach (α) result confirms the data can be used to provide reliable deductions on the study variables as advocated by Murphy and Davidshofer (1988). The results are presented in Table 4.1

Table 2.1: Reliability Test

Variable	Cronbach's Alpha (α)	Number of items in Scale
Advanced Manufacturing Technology	0.9	22
Competitive Advantage	0.8	15
Organizational Resources	0.9	17
Organizational Performance	0.9	14
Acceptable values of α for the study are between 0.58 and 0.97		

Source: Study Data (2021)

Normality Test

Shapiro – Wilk (SW) test was used to determine normality of the study variables. Results show that all the study variable were normally distributed. The results are presented in Table 2.2.

Table 2.2: Shapiro-Wilk Test for each Dimension of the Study

VARIABLES	SW
Advanced Manufacturing Technology	0.949
Competitive Advantage	0.980
Organizational Resources	0.980
Organizational Performance of Large Manufacturing Companies in Kenya	0.942

Source: Study data (2021)

Multi-collinearity Test

Multicollinearity relates to a situation whereby the predictors in a study are to a high extent correlated. The test for multicollinearity was undertaken within the framework of Variance Inflation Factor and the results are presented in Table 2.3.

Table 2.3: Multicollinearity Test

Variable	Collinearity Statistics	
	Tolerance	VIF
Competitive Advantage	0.509	1.963
Organizational Resources	0.600	1.668
Advanced Manufacturing Technology	0.653	1.531
a. Dependent Variable: Organizational Performance in Large manufacturing Companies in Kenya		

Source: Study Data (2021)

The threshold for the multicollinearity test was 5 and the results in Table 4.3 indicate that all the predictors had VIF values below 2 indicating the absence of high collinearity level among the predictor variables.

Hypothesis Testing

The study sought to establish the joint effect of AMT, Competitive advantage and organizational resources on performance of large manufacturing companies in Kenya by testing the following hypothesis: **H₁**: There is a significant joint effect of advanced manufacturing technology, competitive advantage and, organizational resources on performance of large manufacturing companies in Kenya.

This hypothesis was tested based on the output from both simple and multiple linear regression analysis where the p-value method was used. The criterion for the hypothesis test was to reject the hypothesis if the p-value obtained is not significant compared to the threshold value ($\chi = 0.05$). Results of the regression analysis is presented in Table 2.4.

Table 2.4: Regression Analysis Results

	Variable	R	R ²	ANOVA Summary (Regression)		Regression Coefficients			
		R	R ²	F	Sig		Beta	t	Sig
Model 1	AMT	.565 ^a	0.319	19.662	.000 ^b	Constant		13.677	0.000
						AMT	0.565	4.434	0.000
Model 2	AMT, Competitive Advantage	.623 ^a	0.388	13.017	.000 ^b	Constant		4.776	0.000
						AMT	0.380	2.547	0.015
						CA	0.322	2.158	0.037
Model 3	AMT, Organizational Resources	.698 ^a	0.487	19.429	.000 ^b	Constant		4.876	0.000
						AMT	0.353	2.802	0.008
						OR	0.461	3.66	0.001
Model 4	AMT, Competitive Advantage, Organizational Resources	.701 ^a	0.492	12.903	.000 ^b	Constant		3.752	0.001
						AMT	0.316	2.266	0.029
						CA	0.101	0.640	0.526
						OR	0.414	2.853	0.007

a. Dependent Variable: Organizational Performance in Large manufacturing Companies in Kenya

Source: Study Data (2021)

Model 1: Regression of AMT on Organizational performance

Model 2: Regression of AMT and Competitive advantage on Organizational performance

Model 3: Regression of AMT and Organizational resources on Organizational performance

Model 4: Multiple Regression of AMT, Competitive advantage and organizational resources on organizational performance

The results from the multiple regression model 4 (Table 2.4) on the joint effect of AMT, Competitive advantage, Organizational resources and performance of large manufacturing companies in Kenya shows a very strong relationship among the four variables in the study ($R=0.701$). Results from the multiple regression model summary show the joint effect of AMT Competitive advantage and Organizational resources accounts for 49.2% of variations in Performance of large manufacturing companies in Kenya ($R^2= 0.492$). The ANOVA results showing a significant F-ratio ($F= 12.903$, $p < .005$) confirms the suitability of using the multiple regression model on the joint effect in the study.

Further, using the standardized coefficients

and ANOVA results (model 4) in Table 2.4, the results show that AMT statistically predicts the value of performance of large manufacturing companies in Kenya in the presence of competitive advantage and organizational resources at a confidence level of 95% ($\beta = .316$, $t = 2.266$, $p < .05$). This suggests that one unit of increase in AMT in the presence of competitive advantage and organizational resources increases performance of large manufacturing companies in Kenya by 31.6%.

The results also show that competitive advantage is not statistically significant in predicting the value of performance of large manufacturing companies in Kenya in the presence of AMT and organizational resources at a confidence level of 95% ($\beta = .101$, $t = 2.266$, $p > .05$). Despite competitive advantage not being statistically significant in predicting the value of performance in the presence of AMT, the results show that a unit increase in competitive advantage has the effect of increasing the effectiveness of AMT in manufacturing operations by 10.1%.

Further, the results show that organizational resources statistically predict the value of performance of large manufacturing companies in Kenya in the presence of AMT and competitive advantage at a confidence level of 95% ($\beta = .415$, $t =$

2.266 , $p < .05$). This suggests that one unit of increase in organizational resources in the presence of AMT and competitive advantage increases performance of large manufacturing companies in Kenya by 41.5%. Arising from these results, we fail to reject the hypothesis developed in the study (H1) that there is a significant joint effect of AMT, Competitive advantage, Organizational resources on performance of large manufacturing companies in Kenya.

Results in Table 2.4 confirm the joint effect of the three variables in the study, AMT, competitive advantage and organizational resources to be greater than the individual effects of AMT on performance of large manufacturing companies in Kenya. In particular a) AMT alone explained 31.9% of performance (Model 1), b) Joint effect of AMT and Competitive advantage explained 38.8% of performance (Model 2), c) Joint effect of AMT and Organizational resources explained 48.7% of performance (Model 3) and d) Joint effect of AMT, Competitive advantage and Organizational resources explained 49.2% of performance. This finding reveals a positive synergy on the relationship between the three variables and performance of large manufacturing companies in Kenya.



Discussion of Results

The results from this study demonstrated that there is a significant joint effect of AMT, Competitive advantage and organizational resources on performance of large manufacturing companies in Kenya. This result supports the finding by Leonidou, Palihawadana, and Theodosiou, (2011) that the joint effect of strategy, competitive advantage and organizational resources has a positive impact on performance. The synergy from these three variables allows companies to meet their customer needs and wants. These results suggest that organizations that correctly implement AMT in their operations, will deliver better performance compared to those that fail to correctly adopt AMT in their operations (Musebe et.al, 2022).

According to Chen and Small (1994), some manufacturing companies that have adopted AMT in their production systems did not realize the expected benefits. The results from this study encourage managers to identify the correct AMT to fit their manufacturing strategy to fully realize the expected results. In the current turbulent manufacturing environment where manufacturing companies have to continuously review their product and manufacturing strategy, aligning the type of AMT to adopt to the existing internal and external environments, allows optimization of manufacturing processes and capabilities for manufacturing existing products. Therefore, making wrong investments in AMT can be risky and become expensive leading to adverse experiences on performance.

Competitive advantage was not

statistically significant in predicting the value of performance of large manufacturing companies in Kenya in the presence of AMT and organizational resources. This finding confirms the concept of generic competitive strategies as espoused by Corsten and Will (1993) and Musebe et.al (2022), in which AMT supports both cost leadership and differentiation strategies which are assumed to be generally incompatible. Corsten and Will (1993) suggested simultaneity to explain this observation that is divergent to the generally accepted generic competitive strategies. Harris (2012) recognized AMT as an important and special organizational resource, that provides manufacturing companies with the ability to implement both cost leadership and differentiation manufacturing strategies. The finding of this study is in agreement with the classification of AMT as a special organizational resource and emanating from the resource-based view of strategy, it is strategic resources that lead to competitive advantage.

Further, the results also indicate that 50.8% of performance in large manufacturing companies in Kenya is accounted for by other factors that were not considered in this study. According to Shala, Prebreza and Ramosaj (2021), the contingency approach is based on the theory that effectiveness is contingent, or dependent, upon the interplay between different variables and specific situations. Therefore, this finding confirms the contingency approach and theory of management in which the joint effect of AMT, competitive advantage and

organizational resources on performance of manufacturing companies does not account for 100% of performance, but other factors like the size of the company, employee competencies, manufacturing process and environment, also contribute towards performance. In other words, manufacturing companies need to choose the type of AMT to adopt depending on their manufacturing strategy and resources they own.

The study findings on the effect of the three variables in the study on performance supports other studies as well. Tracey, Vonderembse and Lim, (1998); Abungu, Maingi and Ombara (2016); Nyori and Ogola (2015), found a positive and significant relationship between the joint effect of AMT, organizational capabilities, competitive advantage and performance of organizations. Empirical results from the study by Tracey, Vonderembse and Lim, (1998) show that competitive capabilities developed through AMT and resources owned by manufacturing companies lead to high levels of performance as measured by customer satisfaction and marketing performance. Customer satisfaction provides feedback to manufacturing companies on product quality and price acceptance by consumers. Employee retention rates have also been found to increase with adoption of AMT in the production process. Organizations need to retain staff to develop and entrench organizational capabilities, which form part of the intangible organizational resources. Staff retention contributes immensely to skills and organizational memory retention.

CONCLUSIONS AND RECOMMENDATIONS

The study sought to determine the joint effect of AMT, Competitive advantage and organizational resources on performance of large manufacturing companies in Kenya. The study developed four hypotheses that were tested using data collected from 55 large manufacturing companies in Kenya. The study employed both simple and

multiple linear regression to analyze the data. The study concluded that the joint effect of AMT, competitive advantage and organizational resources on performance was more than the individual effect of AMT or any other combination of these variables on performance. Hence, manufacturing companies expect to improve their performance when they

own strategic resources and adopt AMT in their operations. The study recommends that manufacturing companies should consider AMT as important and special organization resources and choose appropriate AMT's aligned to their manufacturing strategy.



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