

**RELATIONSHIP BETWEEN MACHINE INSTALLATION, COMPUTERIZATION AND  
COMPETITIVENESS OF LISTED MANUFACTURING FIRMS IN KENYA**

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**Abstract**

*Organizations are strategically positioning their operations in order to remain competitive with increased globalization. Automation is one of the salient elements for remaining competitive. The objective of the study was to examine the relationship between machine installation, computerization and competitiveness of listed manufacturing firms in Kenya. The study used a descriptive survey design. The target population of this study was 158 manufacturing staff who included 84 head of departments of listed manufacturing firms, 14 CEO's of listed manufacturing firms, 52 staff of Kenya Association of Manufacturers and 8 staff of Industrialization Directorate of Ministry of Industrializations and Enterprise Development. The study adopted a formula by Pagano and Gauvreau (2006) to determine the sample size of this study from a population, whereby a sample size of 113 respondents was established. The sampling technique used was stratified random sampling method. The primary research data for this study was collected using a questionnaire. The questionnaires which were designed to address the research questions and objectives were administered to the Head of departments working in the listed manufacturing firms in Kenya and KAM Staff. Data was cleaned and entered into the Statistical Package for Social Sciences (SPSS Version 20) for analysis. Descriptive statistics was used to analyze the data. Data presentation was done by the use of pie charts, bar charts and tables. Multiple regression analysis and Pearson correlation analysis were further used to establish the relationship between variables. The study results revealed that there was a positive and statistically significant relationship between competitiveness of listed manufacturing firms and machines installation. There was also a positive and statistically significant relationship between computerization and competitiveness of listed manufacturing firms. The study concludes that mechanization of manufacturing firms has a great potential to reduce cost of labor, efficiency in operations and lead to mass production to enhance competitive advantage. Companies that do not mechanize or computerize are likely to find themselves at a competitive disadvantage. The study recommends that manufacturers need to carefully evaluate automation options to craft their strategies for them to be competitive. Kenya must engage an effective strategy for mechanizing or computerizing its manufacturing industries through public-private partnerships, in order to gain global economic competitiveness.*

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**Key Words:** Automation, Competitiveness, Mechanization, Competitiveness, Manufacturing Firms

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## **Background**

Globalization, the internationalization of markets and corporations, has totally changed the way modern corporations do business. For purposes of reaching the economies of scale, it is necessary to achieve low costs and low prices. Companies which need to be competitive begin to come up with “a global market” idea instead of a national market. With the globalization of more industries, strategic management is becoming an increasingly important way to track of international developments and position a company for long-term competitive advantage (Ding, 2011). To survive in today’s business world of constant change and ever increasing complexity demands greater competitiveness in all aspects of the organization’s performance (Groover, 2008). The management and use of the organization’s facilities, the largest asset on the balance-sheet, is no exception. Over the last 25 years organizations struggling to survive and develop in the perilous business environment have identified the facilities base as a key opportunity to increase competitiveness. During this same period the pace of technological change has been phenomenal. Manufacturing firms’ managers have looked for an IT panacea in the form of manufacturing firms’ automation (Wessner, 2012).

There are different forms of automation, the notable ones being mechanized and computerization. Mechanization mainly relates to the physical flow of goods and represents the basic core technologies, such as drilling, grinding. Computerization refers to the flow of information which deals with the control and support of the mechanized technologies while industrial robots are programmable devices consisting of mechanical actuators and sensory organs that are linked to a computer (Frohm, 2009). The mechanization and automation of manufacturing are direct pathways to increase the production efficiency and product quality, by reducing cost and labor demands while improving working environment (Frohm, 2009).

Over the last three decades a growing group of manufacturing firms in the industrialized world have been spending enormous resources in upgrading their production technology to cope with the increasing competition from non-industrialized countries where production costs are much lower. As a result of this, there has been a transition in the manufacturing sector from labor intensive production to capital intensive flexible specialization in the industrialized world (Kromann, Skaksen & Sørensen, 2011). Manufacturing is rapidly transforming the global competitive landscape by marrying industrial automation with information technology to optimize the efficiency, productivity, and output of plants and supply networks. This trend continues to increase the flexibility of plants, reduce the use of energy, improve environmental sustainability, lower the cost of products, and delivers additional benefits such as better product quality and increased worker safety (Nosbuch & Bernaden, 2012).

In this increasingly competitive world there is need to improve performance continually to achieve success. There is a limit to what can be achieved by the application of efficiency measures if operations continue to be based on manual input. To drive improvements further requires increased efficiency and consistency and in many cases this is best achieved by the application of automation. The right investment in modern, automated manufacturing facilities will enable businesses to achieve success in increasingly competitive global markets. Automation of the manufacturing process not only drives costs down; it improves quality, reduces waste and optimizes energy use (Nadine, Terrence, Roma & Leonard, 2014). The concept of competitive advantage is central in strategic management studies (Porter,

1985). Firms need to position themselves in a superior position within an industry than its competitors. Firm competitiveness indicates a firm's ability to design, produce and market products superior to those offered by competitors, where superiority can be evaluated from several factors, like price, quality, technological advancement, etc (Depperu & Cerrato, 2005).

### **Statement of the Problem**

Automation is one of the salient elements for remaining competitive. Without automated production the company simply would not survive (Jabar, Soosay & Santa, 2010). Manufacturing sector is a major source of employment and key to achieving the country's vision of becoming prosperous and globally competitive nation by 2030 (KNBS, 2012). However, some manufacturing firms in Kenya have struggled to make it. There is need to address this problem in order to save the survival and competitiveness of manufacturing companies in Kenya. In turn, this may save the economy from revenue loss, avoid job losses and unbalanced trade. Considering the increasing global competition and the threats of e.g. outsourcing and off-shoring to low-cost countries, competitive manufacturing capability is a critical and urgent matter for manufacturing companies. Mechanization and computerization are often regarded as highly efficient, potentially improving the competitiveness of manufacturing companies. However, they often increase the complexity in structures and control systems, resulting in inflexible monolithic production systems (Zuehlke, 2010). It is thus important to the extent of mechanization and computerization in manufacturing firms in Kenya and how they influence their competitiveness in the local, regional and global market.

There is also limited knowledge and research within this new application area. One of the notable studies in this area is by Mate and Kabiru (2014) who examined automation and changing technologies in the manufacturing industries in Kenya. The results revealed that a large number of manufacturing plants were applying automation and were trying to increase the automation levels of their plants through adoption of computer-based technologies. The study however did not examine how the computer-based technologies influenced competitiveness of the manufacturing firms in Kenya. Otieno (2013) also conducted a study on influence of strategic levers on performance of Kenya's manufacturing firms operating under the East African community regional integration. The author acknowledged that strategic levers comprise of technology acquisition and automation of production. This study did not link the aspects of mechanization and computerization on competitiveness of manufacturing firm. Therefore the study was also motivated to bridge this knowledge gap. It is against this background therefore that the study sought to analyze relationship between mechanization, computerization and the competitiveness of listed manufacturing firms in Kenya.

### **Research Objectives**

- i. To explore the relationship between mechanization and competitiveness of listed manufacturing firms in Kenya.
- ii. To determine the relationship between computerization on competitiveness of listed manufacturing firms in Kenya.

### **Research Hypothesis**

- i.  $H_0$ : There is no significant relationship between mechanization and competitiveness of listed manufacturing firms in Kenya.
- ii.  $H_0$ : There is no significant relationship between computerization and competitiveness of listed manufacturing firms in Kenya.

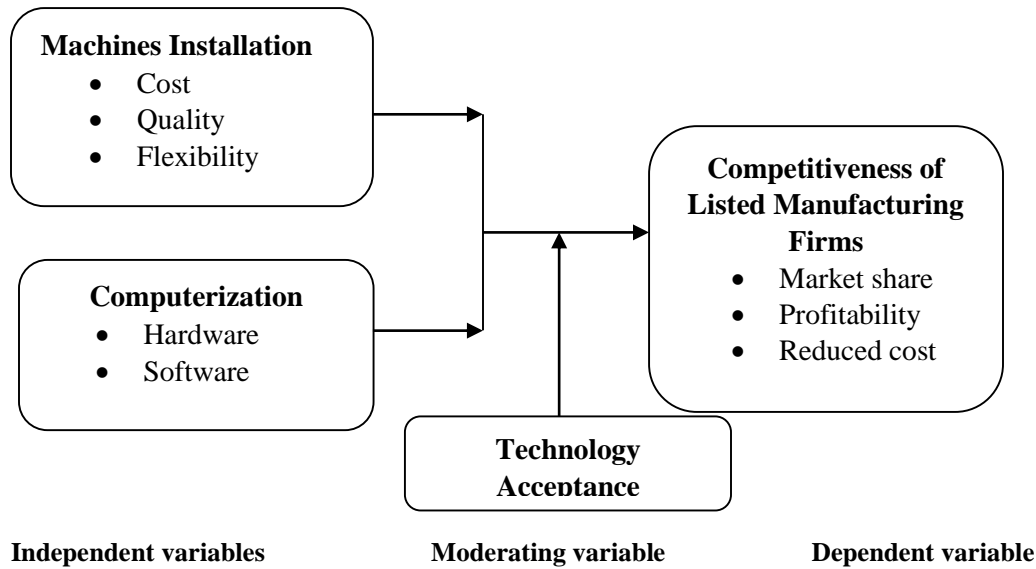
### **Review of Related Literature**

This study was anchored on Porters Diamond Theory which was developed in 1990 by Michael E. Porter. This is a theory of National Advantage, which is a model that is designed to help understand the competitive advantage nations or groups possess due to certain factors available to them, and to explain how governments can act as catalysts to improve a country's position in a globally competitive economic environment. Porter revealed that a nation's competitiveness depends on the capacity of its industries to innovate and upgrade where pressure and challenge motivate companies to gain advantage against the world's best competitors (Porter, 1998). Porter focus on nations' specific industries and industry segments and the way they evolve in their struggle for competitive advantage against foreign competitors, how industries support each other, and the way they are able to amplify their home based advantages (Porter, 2008). A nation's companies struggle to raise product quality, add desirable features, improve product technology, or boost production efficiency. Germany, for example, has enjoyed rising productivity for decades as its companies have been able to produce increasingly differentiated products and introduce rising levels of automation to enhance the output per worker (Porter, 2008).

This theory was applicable in assessing the competitiveness of manufacturing firms in Kenya. The theory helps to analyze whether the Kenyan manufacturing industries are globally competitive. Secondly, application of this theory helps to identify the sources of competitive advantage such as factor conditions (cost, skills and knowledge, quality), demand condition, related and supporting industries, clustering, technology, firm strategy, structure, and rivalry. Finally, use of Porter's theory helps to address issues of what actions to take to sustain the competitiveness of this sector.

### **Conceptual Framework**

The conceptual framework reflects the relationship between the variables of the study. The independent variables are mechanization and computerization while dependent variable was the competitiveness of listed manufacturing firms in Kenya. The relationship between the independent and dependent variables was moderated by technology acceptance.



### Research Methodology

The study will adopt a descriptive research design. A descriptive study is concerned with finding out the what, where and how of a phenomenon (Creswell, 2014). The study population was 14 listed manufacturing firms in NSE in the year 2014 before reclassification. The target population of this study was 158 staffs who include: 42 heads of departments of listed manufacturing firms, 42 assistant heads of departments of listed Manufacturing firms, 14 CEO's of listed manufacturing firms, 52 staff of KAM and 8 industrialization directorate of Ministry of Industrialization and Enterprise Development. The study population was drawn from the following departments of manufacturing firms: production, research and planning and technical/engineering. The Pagano and Gauvreau (2006) formula was adopted to calculate the sample size of this study from a population of 158 respondents to give a sample size was 113 respondents. The study used stratified random sampling method which is best sampling method because the study has accurate and easily accessible sampling frame that lists the entire population in different stratum or sectors. The sample size of this study was comprised of 30 heads of departments, assistant heads 30 of departments of listed manufacturing firms, 10 CEO's of listed Manufacturing firms, 37 Staff of KAM and 6 Industrialization Directorate of Ministry of Industrializations and Enterprise Development. Thus the sample size was 113 respondents.

The study used primary data which was collected using questionnaires. The questionnaires were designed to address the research questions and objectives were administered to the Head of Departments working in the listed manufacturing firms in Kenya and KAM Staff. Interviews were also conducted through the use of an interview guide. The interview guide helped to probe deeper from the CEO's of manufacturing firms and industrialization directorate of Ministry of Industrializations and Enterprise Development to get deeper information on the relationship between automation strategy and competitiveness of listed manufacturing firms in Kenya. Secondary data was obtained from literature or from data that has been collected from other people either for research or for other purposes in form of textbooks; published and unpublished thesis, journal articles and information from the internet was used to support

the research findings. Descriptive statistics such as means, standard deviation and frequency distribution were used to analyze the data. The analyzed data was presented by the use of pie charts, bar charts and graphs, percentages and frequency tables. The study used a regression analysis to determine the relationship between variables. The regression models took the following form:

$$Y = \beta_0 + \beta_1 MI + \beta_2 C_2 + \varepsilon$$

Y is Competitiveness of listed manufacturing firms in Kenya, MI is Machines Installation,  $C_2$  is computerization,  $B_0$  is the constant,  $\beta_1$  is coefficient and  $\varepsilon$  is the error term.

**Results**

The first objective of the study was to explore the relationship between mechanization and competitiveness of listed manufacturing firms in Kenya. A scale of 1-5 was used to interpret the results where 5 represented strongly agreed, 4 was agree, 3 was Neutral, 2 was disagree, while 1 was strongly disagree. Results in Table 1 show that there was great use of electrical machines in their firms (mean score = 4.3537), use of hydraulic machines (mean score = 4.2195), pneumatic machines (mean score = 4.1585), electronic machines (mean scores = 4.1463) and great use of heavy industrial machines in the manufacturing firms (mean score = 4.0610).

**Table 1: Mechanization in Listed Manufacturing Firms**

Statements on Machines Installation	Mean	Std. Deviation
There is a great extent of use of hydraulic machines in this manufacturing firm	4.2195	0.83184
There is a great extent of use of pneumatic machines in this manufacturing firm	4.1585	0.86737
There is a great extent of use of electrical machines in this manufacturing firm	4.3537	0.93455
There is a great extent of use of electronic machines in this manufacturing firm	4.1463	0.81834
There is use of heavy industrial machines in this manufacturing firm	4.0610	0.75926

The second objective was to determine the relationship between computerization on competitiveness of listed manufacturing firms in Kenya. A scale of 1-5 was used to interpret the results where 5 represented strongly agreed, 4 was agree, 3 was Neutral, 2 was disagree, while 1 was strongly disagree. Results in Table 2 indicate that there was a great use of computer programmes in production operations in listed manufacturing firms in Kenya (mean score = 4.1463). There was also great use of computerized technology to control and support mechanized technologies (mean score = 4.0854). The manufacturing firms also used Computer Integrated Manufacturing (CIM) programmes (mean score = 3.9877) as well as hardware technology and software technology in their operations (mean scores = 3.9146).

**Table 2: Computerization in Listed Manufacturing Firms**

Statements on Computerization	Mean	Std. Deviation
The firm uses computerized technology to control and support mechanized technologies	4.0854	0.91895
There is a great extent use of hardware technology in this manufacturing firm	3.9146	0.80433
There is a great extent of use of software technology in this manufacturing firm	3.9146	0.91895
There is a great extent of use of computer programmes in production operations	4.1463	0.99532
The manufacturing firms use Computer Integrated Manufacturing (CIM) programmes	3.9877	1.04276

The regression results in Table 3 shows that there was a positive and statistically significant relationship ( $\beta = 0.238$ ,  $p=0.039<0.05$ ) between machines installation and competitiveness of listed manufacturing firms. The results also show a positive and statistically significant relationship ( $\beta = 0.401$ ,  $p= 0.000<0.05$ ) between computerization and competitiveness of listed manufacturing firms.

*Table 3: Regression Coefficients*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.893	0.568		3.334	0.001
	Machines Installation	0.238	0.113	0.210	2.103	0.039
	Computerization	0.401	0.099	0.406	4.067	0.000

a Predictors: (Constant), Machines Installation, Computerization,

b Dependent Variable: (Competitiveness)

The correlation results in Table 4 which found a positive and statistically significant relationship between machines installation and competitiveness of listed manufacturing firms ( $r = 0.321$  and  $p=0.003 <0.05$ ). We therefore reject the null hypothesis that, there is no significant relationship between machines installation and competitiveness of listed manufacturing firms in Kenya; and accept the alternative hypothesis that: there is a significant relationship between machines installation and competitiveness of listed manufacturing firms in Kenya. These results also show a positive and statistically significant relationship between computerization and competitiveness of listed manufacturing firms ( $r=0.462$  and  $p= 0.000<0.05$ ). Thus we reject the null hypothesis and accept the alternative hypothesis that; there is a significant relationship between computerization and competitiveness of listed manufacturing firms in Kenya.

*Table 4: Correlation Results*

		Competitiveness	Machines Installation	Computerization
Competitiveness	Pearson Correlation	1		
	Sig. (2-tailed)	.		
Machines Installation)	Pearson Correlation	0.321(**)	1	
	Sig. (2-tailed)	0.003	.	
Computerization	Pearson Correlation	0.462(**)	.120	1
	Sig. (2-tailed)	0.000	.283	.

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

\* Correlation is significant at the 0.05 level (2-tailed).

## **Conclusion**

The study concludes that mechanization of manufacturing firms has a great potential to reduce cost of labor and leads to mass production. Mechanization when incorporated in the production line proves to be the most efficient way in order to carry out mass production in most of the manufacturing firms. Mechanized production line also saves time and costs; it raises labor productivity and free humans from heavy, labor-intensive operations. Mechanization also enhances efficiency in the firms' operations such as processing, assembly, or material handling, which puts the firm in the frontline against its competitors.

The study concludes that it is imperative for the manufacturing firms in Kenya to consider the usefulness and use of ease of a technology before being adopted. The perceived benefits of the technology/automation should be highlighted; for instance can it increase quality products, efficiency, high volume of production and low production cost. There is a significant competitive advantage gained in automating a manufacturing plant. The benefits of automation often show up in many ways, such as in improved quality, higher sales, increased labor productivity, reduced labor cost, reduction or elimination routine manual and clerical tasks, reduction in manufacturing lead time and accomplishing processes that cannot be done manually. Companies that do not mechanize or computerize are likely to find themselves at a competitive disadvantage with their customers, their employees, and the general public.

Automated manufacturing systems are regarded as highly productive, which improves company's competitiveness. This is a relevant matter for manufacturing companies today, considering the increasing global competition and the threats of outsourcing to low wage countries, etc. When planning and implementing automated manufacturing systems there is however a number of issues to consider. Besides high investment costs, automated systems are vulnerable to unforeseen situations where no predefined solutions can be applied. The prevalent solution is to combine manual and automated operations, thus achieving a semi-automated manufacturing system. Such hybrid systems are able to reap the benefits from added efficiency and productivity resulting from automation. At the same time, semi-automated systems utilize the flexible resources provided by the humans in the system. An appropriate allocation of tasks between technology and operator contributes to the creation of competitive manufacturing system.

## **Recommendations**

### **Recommendations for Practitioners**

Manufacturing firms are striving hard to be competitive amid increasingly complex and competitive industry dynamics. Managing business challenges while ensuring competitiveness demands a change in automation strategy. The Kenya manufacturing firms should aim to improve the competitive capacities and enable their manufacturing firms to meet international competitiveness requirements, such as product quality and cost. Thus manufacturing firms should aim to strengthen the capacities by automating for them to participate in international trade, and specifically to enable them to be globally competitive. There is a widespread consensus that 'business as usual' is no longer an option, adoption of automation is a necessity; otherwise more Kenyan manufacturing industries will shut their operations.



Kenya must engage an effective strategy for mechanizing and computerizing its manufacturing industries through public-private partnerships, in order to gain global economic competitiveness. Acting now will deliver near-term and long-term economic gains for Kenyan's industries and consumers. Delaying will hand those successes to the economies of other nations. Kenyan manufacturers must have the support of the public sector to catalyze breakthroughs with automation in rapidly successive phases. Public-private partnerships will advance applied research, mitigate risk in the initial phases of this change, and spread the benefits rapidly throughout the nation's businesses.

As automation technologies get their ways into manufacturing, companies may grapple with the application of automation to blend with the human labour. Manufacturers could be at trying to figure out the extent to which they should automate change in the varied manufacturing tasks and as they call for greater human-machine collaboration and still enhance competitiveness. Manufacturers should therefore prepare for the implications of displacing human workers with automation technologies. Employees are in jobs that could be at risk of being displaced by automation technologies. As automation technologies become more pervasive on factory floors, employers and employees will need to manage not only the benefits but also the human-resource challenges that their rise will likely prompt.

### **Recommendations for Further Study**

Certainly, manufacturers are approaching automation in many and varied ways, and assessing the degree of need and spotting the "right" application differ across industries and from manufacturing plant to manufacturing plant. As companies' especially small and mid-sized enterprises look for new and viable ways to integrate automation into their operations, automation is becoming a stronger factor in manufacturing competitiveness globally. Thus there is need for future scholars to assess automation readiness and develop a guideline for the human-machine transition in quest of adapting proper automation levels with minimal negative consequences of manufacturing firms in Kenya.

Future academicians can debate whether Kenyan's labor surplus impeded the country's automation adoption. Future researcher should also develop a guideline that allows companies to choose the most appropriate automation level to be implemented to justify the implementation cost and provide optimum relation with the human resource.

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