INFLUENCE OF DATA SCIENCE SKILLS ON PERFORMANCE OF MANUFACTURING FIRMS IN NAIROBI CITY COUNTY IN KENYA

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ABSTRACT

Purpose of the Study: The study aimed to examine how data science skills affected the performance of manufacturing firms among selected manufacturing firms in Nairobi, Kenya.

Statement of the Problem: The contribution of Kenya's manufacturing sector to GDP has declined from 13.8% in 2020 to 12.9% in 2021, falling short of the Vision 2030 target of 20%, with decreasing sales turnover.

Methodology: The study utilized a quantitative approach with a descriptive survey design, targeting 253 senior managers across various departments. A sample of 75 managers (30% of the population) was selected, and data was collected through structured questionnaires. Analysis involved descriptive statistics, with results presented in tables and charts.

Findings: The results indicated that data science skills have a significant positive effect on the performance of manufacturing firms in Nairobi City County, Kenya. The study found that technical skills accounted for 60.7% of the substantial variation in outcomes for these firms (R square = .607).

Conclusion: The study concluded that data science skills significantly enhance the performance of manufacturing companies in Nairobi City County, Kenya, emphasizing the need for investment in these skills and a data-driven culture.

Recommendations: The study recommended that firms invest in data science skills and cultivate a data-driven culture by equipping employees with the necessary tools and encouraging data-informed decision-making.

Key Words: *Data Science Skills, Manufacturing Firms, Firm Performance, Nairobi City County, Kenya*

INTRODUCTION

The primary role of manufacturing firms is to increase turnover, which implies an improvement in productivity. According to Issack and Muathe (2017), firms should take informed actions to achieve both short-term and long-term production goals. This necessitates planning to protect firms from the uncertainties that come with unpredictably changing conditions. The differential success of firms is often attributed to organizational reactions and informed decision-making (Okoth & Njeru, 2019).

The primary goal of enterprises is to maximize profit, making the concept of organizational performance essential. Gure and Karugu (2018) argue that successful companies must generate higher profits and analyze execution drivers from the strategic level down to the operational level. The environment in which companies operate has not only become more uncertain but also more interconnected and disruptive (Teece, 2018).

Technical skills, defined as specialized knowledge and expertise that enable employees to perform specific tasks and use particular tools and programs, are crucial for increasing firm performance. These skills are dynamic and required across all fields and industries, from IT and business administration to healthcare and education. Technical skills contribute to overall organizational success and assure employees of better job opportunities, higher salaries, and increased career stability (Bontis, 2018).

Focusing on enhancing technical skills can maximize production by helping build a competitive advantage (Wang et al., 2018). Technical skills are a strategic aspect that provides companies with long-term direction to handle variations and concentrate on improvements. Productivity becomes a key focus when enhancing technical skills, as firms must develop their own metrics and strategies depending on the industry they operate in (Nosratpour et al., 2018).

It is well-known that Africa's manufacturing sector, especially in Sub-Saharan Africa, is underperforming. A 2019 World Bank research found that Africa's industrial firms were struggling, contributing only 3.8%-11% to GDP compared to 30%-40% in industrialized countries, according to the African Development Bank (AFDB, 2016). The AFDB report from 2016 highlighted that manufacturing enterprises in Kenya have been performing poorly as a source of total GDP growth. Similarly, the Kenya Strategic Policies for Vision 2030 study (2018) noted that manufacturing performance began to deteriorate in the mid-1980s (Agwu, 2018).

Performance, is a method for evaluating an organization's performance based on specific criteria like total revenue, sales, and effectiveness of processes. For there is a lot of strategic thinking which focuses on introducing and weighing performance, management of performance and development is the central focus of plan of action management (Gartenberg et al., 2019). According to (Korir et al., 2020) organization's performance is influenced by three ideologies: the goal approach, which says that an organization works toward specific, measurable objectives, in which overall increase in revenues is key. Manufacturing enterprises, in accordance to the World Bank (2019) are the major source of employment in both growing and developed economies, accounting above 90% of African company activities and contributing to over 50% of Africa employment ratio and GDP. Because of Africa's resources, which human capital is key, the encouragement of manufacturing enterprises, particularly those in metropolitan areas to manage human resources, is seen as a potential path to sustainable development (Brandt, 2019). 80% of Kenya's manufacturing firms are centered in Nairobi, the country's capital, which is well-connected and well-equipped with training institutions and better infrastructure (Samuel et al., 2021).

The focus on technical skills has experienced rapid expansion over the past two decades (Malykhin et al., 2021), and this expansion continues on a daily basis. Acquisition of technical skills is frequently a crucial aspect of the strategic management process, as it incorporates all divisions of an enterprise company. This is targeted at employee competency, and companies should demonstrate such desire in strategy execution because the outcomes of skills enhancement can affect a company's success or failure in its industry. Because no company has infinite resources, strategists must determine the other strategies, which will benefit the company the most (McGuinness, 2023).

Manufacturing makes up 70% of Kenya's industrial sector's GDP, with the remaining 30% coming from building, construction, mining, and quarrying (Kenya Association of Manufacturers, 2015). According to Kenya Vision 2030, manufacturing will play a major role in achieving a 10-percent annual growth rate in GDP. In terms of job creation and GDP expansion, manufacturing has a lot of untapped potential. For instance, the manufacturing sector, in contrast to agriculture, which is severely constrained by land size, holds a lot of promise for job creation and poverty reduction (Barasa, 2018). The nation's capital, Nairobi, is home to eighty percent of manufacturing companies, and it is well-connected and well-equipped (World Bank's report, 2015). Although its contribution to wage

employment has been decreasing, the manufacturing sector's contribution to GDP has remained stable at around 10%. The first Medium Term Plan (MTP) goals for implementing Vision 2030 from 2008 to 2012 were mostly not met in terms of the sector's contribution to GDP and the completion of major projects. Vision 2030 envisions a manufacturing sector that is dynamic, diverse, and competitive, able to drive employment.

Statement of the Problem

Following farming and gardening, manufacture in Kenya is the third most important contribution to GDP. Despite this, the manufacturing sector growth dropped down in 2020 to 4.4%, from 5.8% in 2019, and has continued to have mixed (KAM, 2019). The contribution of the sector to total pay employment has deteriorated, falling from 13.8% in 2020 to 12.9% in 2021. (KIPPRA, 2021). This suggests that the manufacturing sector in Kenya is still a long way from contributing 20% of GDP as envisaged in Vision 2030. The sales turnover of manufacturing firms in Kenya as measure of performance has been decreasing in recent years. In 2022, the total sales turnover of manufacturing firms in Kenya was estimated to be Ksh 3.5 trillion (approximately USD 30 billion). This represents a decrease of 10.2% from 2021 (KAM, 2022). There have been some fluctuations in the net profit margin of manufacturing firms in Kenya over the past few years. For example, in 2022, the net profit margin declined to 9.3% due to cost of production including energy, currency fluctuation and competition from imported goods (KAM, 2022). As a result, the sector's contribution to GDP has remained relatively stagnant at around 5%. The above issues require an examination of alternative strategies that can contribute to sustainable performance and thus the need to examine the influence of technical skills in sustaining firm performance in the manufacturing sector.

Objective of the Study

To assess the effects of data science skills on performance of manufacturing firms in Nairobi City County in Kenya.

LITERATURE REVIEW

Theoretical Literature Review: Human Capital Theory

According to Schultz's (1972) Human Capital Theory, value creation in a firm may lead to improved business production. It suggests that a company's employees are assets rather

than costs. Bontis (2008) says that an organization's human aspect, or the combination of intelligence, expertise, and skills that gives it personality, is called human capital. The HCT places an emphasis on the value that people can add to a company. This position is referred to as a "human capital advantage". Businesses can and do benefit from the high levels of training and expertise that their employees possess despite the fact that they do not legally own human capital. They can do this by employing strategies like creating corporate cultures or learning vocabulary terms to foster unity and impart technical skills to employees. The theory's premise is based on the immeasurable nature of human capital's many manifestations.

Human capital, on the other hand, has an intrinsic value that cannot always be quantified. Second, regular research and observation are challenging due to the fact that human capital can be stored but not always utilized fully (Boxall, 2011). It is therefore essential to have technical skills. The total amount of human capital is determined by Nafukho (2004) as the sum of all types of human capital.

Empirical Studies

Wang and Li (2019) conducted a seminal study on the impact of data science skills on business performance within the manufacturing sector. Employing a quantitative survey methodology, they gathered data through questionnaires distributed to manufacturing firms. Through rigorous regression analysis, they assessed the relationship between employees' data science skills and key business performance indicators, such as productivity, innovation, and profitability. Their findings unequivocally suggest a positive association between employees' data science skills and business performance. Specifically, firms with employees who possess advanced data science skills exhibit higher levels of productivity, innovation, and financial performance.

Similarly, Chen and Zhang (2020) investigated the influence of data science skills on financial performance, focusing on companies in the financial services sector. Utilizing a mixed-methods approach, they combined quantitative analysis of financial data with qualitative interviews of financial professionals. Employing statistical techniques, including regression analysis, they examined the relationship between firms' data science capabilities and financial performance metrics, such as return on investment and profitability. Their study revealed a robust positive correlation between firms' data science capabilities and financial performance, indicating that companies with stronger data

science capabilities achieve higher profitability and maintain a competitive advantage in the financial services industry.

Liu and Wang (2018) explored a different dimension by examining the impact of data science skills on academic performance among university students in STEM fields. Through a quantitative survey methodology, data were collected via questionnaires administered to undergraduate and graduate students. Regression analysis was employed to determine the relationship between students' data science skills and academic performance indicators, including grades and research output. Their findings highlight a significant positive correlation, demonstrating that higher levels of data science skills are associated with superior academic outcomes, such as higher grades and increased research productivity.

Expanding the context to the healthcare sector, Park and Lee (2017) investigated the influence of data science skills on organizational performance. Utilizing a quantitative survey methodology, they collected data from healthcare organizations through questionnaires. Through comprehensive statistical analysis, including regression analysis, they explored the relationship between organizations' data science capabilities and performance metrics, such as patient outcomes and operational efficiency. Their findings reveal a positive relationship, indicating that healthcare organizations with advanced data science skills show marked improvements in patient care, operational efficiency, and overall organizational effectiveness.

Lastly, Kim and Lee (2019) aimed to assess the impact of data science skills on marketing performance within the retail industry. Employing a mixed-methods approach, they combined surveys with analysis of marketing metrics and sales data. Through detailed statistical analysis, including regression analysis, they examined the relationship between employees' data science skills and marketing performance indicators, such as customer engagement and sales revenue. Their study concluded that there is a positive association between employees' data science skills and marketing performance, with retail firms demonstrating higher levels of customer engagement, sales conversion rates, and revenue growth when their employees possess advanced data science skills.

RESEARCH METHODOLOY

The study employed a quantitative research design to collect data that would answer the research objectives comprehensively. A descriptive research strategy was adopted,

allowing the examination of the background of the research problem and determining the characteristics of respondents such as their opinions, traits, and performance behaviors related to employee retention. The target population consisted of 253 business development, strategic, and innovation managers from selected manufacturing companies in Nairobi County, considered leaders in growth initiatives. Simple random sampling was used to select a representative sample of 76 respondents, which is 30% of the total population. Data was collected using structured questionnaires with closed questions, preferred for their efficiency in gathering large amounts of data quickly. The questionnaire was piloted in Kiambu County with eight participants to ensure reliability and validity, achieving Cronbach alpha coefficients of 0.761 for data science skills and 0.844 for firm performance, indicating strong internal consistency. Descriptive statistics were applied to the numerical responses, with data presented using tables, charts, and frequencies. Cross-tabulations were also conducted for further interpretation. The fundamental statistical metrics, such as mean, median, mode, and measures of dispersion, were used to summarize data. SPSS version 26.0 was employed for data analysis, utilizing simple linear regression to represent the relationship between the independent and dependent variables.

FINDINGS AND DISCUSSION

4.1 Descriptive Statistics

The respondents were asked to rate their extent from 1 not at all to 5- very great extent. The results are presented in Figure 6
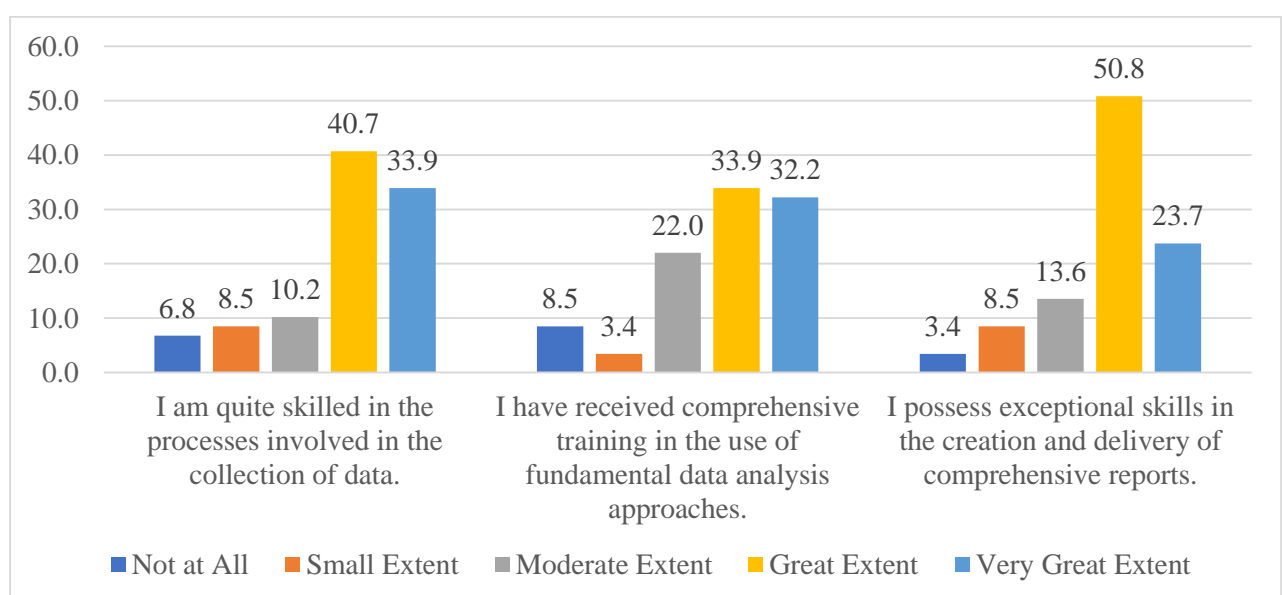

Figure 1: Descriptive Statistics for Data Science

As indicated in Figure 1, 40.7% of the respondents confirmed that they are quite skilled in the processes involved in the collection of data and additional 33.9% indicated they are quite skilled at very great extent. On the other hand, 6.8% indicated that they are not skilled at all while 8.5% indicated they are skilled at small extent in the processes involved in the collection of data. Proficiency in data collection processes is essential for gathering accurate and reliable data, which forms the foundation for informed decision-making and analysis within organizations (Hair et al., 2019). Effective data collection requires attention to detail, adherence to established methodologies, and the ability to identify and address potential biases or errors in the data collection process (Bryman, 2016).

The results further revealed that 33.9% indicated that they have received comprehensive training in the use of fundamental data analysis approaches at great extent while 32.2% at very great extent. These contradicted 8.5% who indicated that they have not received comprehensive training in the use of fundamental data analysis approaches at all while 3.4% indicated at small extent. Comprehensive training in data analysis approaches equips individuals with the necessary skills and techniques to analyze and interpret data effectively, enabling evidence-based decision-making and insights generation (Field, 2018). Training in fundamental data analysis approaches may encompass various statistical methods, data visualization techniques, and software tools commonly used for data analysis, such as SPSS, R, or Python (Kabacoff, 2015).

Lastly, 50.8% of the respondents indicated they possess exceptional skills in the creation and delivery of comprehensive reports at great extent and 23.7% at very great extent. However, 3.4% indicated they do not possess exceptional skills in the creation and delivery of comprehensive reports at all while 8.5% at small extent. Proficiency in report creation and delivery is crucial for effectively communicating insights and findings derived from data analysis to stakeholders within and outside the organization (Kaplan & Norton, 2016). Exceptional skills in report creation involve not only the ability to present data in a clear and concise manner but also the capacity to tailor reports to the specific needs and preferences of the audience (Few, 2013).

Overall, these findings highlight the significance of proper training and education in developing essential analytical skills, including data collection, analysis, and presentation, as noted in prior literature (e.g., Galvis & Rodríguez, 2018; Tseng et al., 2018). By equipping individuals with robust data literacy, employers stand to gain valuable insights and informed decision-making capabilities, ultimately leading to competitive advantages within their respective markets (Dhar, 2013; Ngai et al., 2015).

4.2 Linear Regression Analysis

In the study, the researchers utilized a statistical technique known as simple linear regression to analyze the relationship between two variables: Data science skills and the performance of manufacturing firms. Simple linear regression helps in understanding how changes in one variable (Data science skills) relate to changes in another variable (firm performance). By employing this method, the researchers aimed to quantify the extent to which Data science skills influence the performance outcomes of manufacturing firms.

This analysis helps in identifying the significance and direction of the relationship between the variables, providing valuable insights into the impact of Data science skills on firm performance. The results are indicated in Table 1.

Table 1: Linear Regression of Data science skills on the Performance of manufacturing firms

Model Summary				
Model	**R**	**r-square**	**Adjusted r-square**	**Std. Error of the Estimate**
1	.690[a]	.477	.468	.29278

ANOVA[a]					
Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1 Regression	4.451	1	4.451	51.927	.000[b]
Residual	4.886	57	.086		
Total	9.337	58			

Coefficients[a]					
	Unstandardized Coefficients		**Standardized Coefficients**		
Model	**β**	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	1.473	.394		3.743	.000
Data science skills	.652	.090	.690	7.206	.000
Dependent Variable: Firm performance					

As indicated in Table 1 ANOVA test findings shows that F-Statistic is significant, $F_{(1, 57)} = 51.927$, p-value = 0.000< 0.05; the results are an indication that the model was found to be a good fit to modelling the linear relationship between data science skills and the performance of manufacturing firms in Nairobi City County in Kenya. The model (data science skills) explained 47.7% of variation in the performance of manufacturing firms in Nairobi City County in Kenya as indicated by the r-square = 0.477 (See Table 1).

The findings of the regression Coefficient shows that the unstandardized beta coefficient for the Data science skills variable is significant as shown in Table 1 above; β= 0.652, t = 7.206, p=0.000 <0.05; therefore, that data science skills had a statistically significant influence on the performance of manufacturing firms in Nairobi City County in Kenya. Data science skills had a positive standardized beta coefficient value of 0.690 as shown in the coefficients results of Table 1; these findings indicate that a unit improvement in the practice of data science skills is likely to improve performance of manufacturing firms in Nairobi City County in Kenya by 65.2%. The constant in the model was found to be statistically significant; β=1.473, t = 5.577, p=0.000 <0.05 (see Table 1); this finding indicates that, besides the data science skills in the model, there are other factors not captured in the model that significantly influence performance of manufacturing firms in Nairobi City County in Kenya. To predict the performance of manufacturing firms in

Nairobi City County in Kenya when the level of data science skills, the following model would be used;

$$Firm\ performance = 1.473 + 0.652\ Data\ science\ skills$$

Data science skills have emerged as a critical factor driving the performance of manufacturing firms in Nairobi City County, Kenya. These skills enable firms to harness data for decision-making, optimize processes, and drive innovation, positioning them as industry leaders and ensuring long-term competitiveness and sustainability. The ability to gather, analyze, and derive actionable insights from large volumes of data allows firms to gain deeper insights into their operations, identify areas for improvement, and make more informed decisions (Mikalef, Pappas, Krogstie & Giannakos, 2018). By analyzing data from various sources, data scientists can uncover hidden patterns and trends, automate and streamline manufacturing processes, and enhance customer satisfaction through better understanding of customer needs and preferences (Hagen, 2021).

The implications of data science skills on the performance of manufacturing firms are profound. Data science enables manufacturers to optimize production processes, leading to streamlined operations, reduced waste, and cost savings (Nduati, 2023). It also empowers firms to understand customer demands and market trends, tailoring products, and improving marketing strategies with agility (Allioui & Mourdi, 2023). Additionally, predictive maintenance facilitated by data science reduces downtime and maintenance costs. Despite challenges such as initial investment in technology and skill development, and concerns about data privacy and security, the potential benefits are significant. Data science skills can enhance operational efficiency, customer satisfaction, and overall competitiveness, making them a vital investment for manufacturing firms aiming to thrive in the digital age (Singh, Rajest, Hadoussa, Obaid & Regin, 2023).

The findings align with the study conducted by Yahya, Iskandar, and Sunardi (2017), which demonstrated that the use of a scientific approach significantly enhances the acquisition of technical competencies and has a positive influence on the job-ready abilities of vocational learners. Therefore, it can be said that the cultivation of technical skills and job readiness abilities may be achieved by using a scientific methodology. In a recent study conducted by Manjushree, Varsha, Arvind, and Laxman (2021), it was determined that the enhancement of technical skills was shown to have a positive and incremental impact on subordinate views of managing performance, surpassing the influence of managerial skills alone.

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success, with technical skill serving as an incremental predictor of managerial performance beyond the influence of managerial ability.

CONCLUSIONS

The study concludes that data science abilities have a notable impact on technical skills within manufacturing firms located in Nairobi City, with sufficient information establishing a correlation between these abilities and the performance of manufacturing enterprises in Nairobi City County, Kenya. The favorable impact of data science skills on the performance of these industrial enterprises is indisputable. Firms with a strong foundation in data science are better equipped to make informed decisions, improve efficiency, enhance product quality and innovation, and remain competitive in a rapidly changing market. This underscores the importance of investing in data science capabilities to achieve improved operational efficiency, product quality, and innovation, ultimately positioning firms to adapt to market changes and maintain a competitive edge.

RECCOMMENDATIONS

The study recommends that, in addition to investing in data science skills, firms should create a data-driven culture. This can be achieved by encouraging employees to use data to inform their decisions and providing them with the necessary tools and resources. By fostering a data-driven culture, firms can fully realize the benefits of data-driven decision-making. To remain competitive and thrive in an increasingly data-driven world, manufacturing firms in Nairobi City County should continue to embrace data science and invest in developing these skills among their workforce.

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