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THE INFLUENCE OF BIG DATA ANALYTICS ON INNOVATION OUTCOMES AMONG SELECTED ENTERPRISES IN NAIROBI COUNTY, KENYA

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Abstract

Organizations that effectively utilize big data can analyse consumer behavior, optimize supply chains, and predict market trends, thereby enhancing innovation performance. However, the extent to which big data analytics influences innovation outcomes varies depending on factors such as industry type, technological readiness, and organizational capabilities. Business enterprises in Nairobi County play a significant role in Kenya's economic growth through contributions to employment, competitiveness, and innovation. Despite their potential, many of these enterprises face challenges in sustaining innovation due to limited access to finance, inadequate technological adoption, and suboptimal use of data in decision-making. The general objective of this study was to examine the influence of big data analytics on innovation outcomes among selected enterprises in Nairobi County, Kenya. A multiple case study research design was adopted, with a case selection that identied and engaged select enterprises that had implemented or were adopting big data analytics. Data were collected through semi-structured interviews and document analysis. The findings revealed that big data analytics plays a transformative role in enhancing innovation among selected enterprises, resulting in faster product development, improved customer insights, and greater operational efficiency. The extent of these benefits depended on organizational readiness, including infrastructure, data talent, and strategic alignment. Leadership emerged as a critical enabler, with data-literate and visionary executives fostering adoption while promoting a culture of experimentation and agility. Finally, contextual factors such as regulatory compliance and ethical considerations were found to influence the adoption and effectiveness of big data analytics.

Key words: Big Data Analytics; Innovation Outcomes; Business Enterprises, Nairobi County, Kenya.

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Introduction

Technology has developed a revolutionary change in the business innovation environment. With advanced tools and technology, it is extremely convenient to harvest data and discovering insights from the data for use in managing business and innovation activities (Akter et al., 2022). Big data impacts firm innovation and altered determinants of competitiveness and innovation for businesses. Likewise, firms that are capable of tapping the potential afforded by big data in business process improvement can increase their efficiency and revenue (Wright et al., 2019). Innovation outputs include product innovation, process innovation, new business models, new value chains, and organizational performance. Successful innovation and new product and service expansion through innovation are extremely crucial to the survival and success of business organizations regardless of their size. Innovation is a very critical driver of growth and competitiveness for businesses, particularly in the rapidly changing market. These businesses typically engage in various forms of innovation including product, process, and marketing innovations in order to enhance their performance and position in the market (Gachara, 2017).

Big Bata Analytics (BDA) has emerged as a source of innovation and competitiveness for various industries. Organisations can gain insight into the market patterns, consumer behaviour, and operational effectiveness from a vast volume of data, enabling data-driven decision-making and strategic innovation (Mikalef & Gupta, 2021). Small and selected businesses that play an important role in economic development face challenges in terms of innovation due to lack of resources and inability to harness advanced technology (Akter et al., 2022). However, the application of BDA enables them to automate processes, develop product innovation, and formulate innovative business models that enhance market responsiveness (Wamba et al., 2020). In volatile markets, businesses that use big data effectively can anticipate customers' preferences, refine processes, and ensure competitive advantage (Xie et al., 2023).

Big data refers to large and complex datasets that require advanced analytical methods to extract meaningful insights. Wamba et al., (2020) define big data as high-volume, high-velocity, and high variety information assets that necessitate novel processing methodologies and analytical approaches to improve decision-making. Similarly, Chen et al., (2021) describe big data as the ability to store, manage, and aggregate structured and unstructured data to identify patterns and trends that facilitate data-driven decisions. De Mauro et al., (2018) also characterize big data as increasingly large and complex datasets that demand specialized analytical workflows to generate actionable meaning. These definitions reflect the 5Vs of big data—volume, velocity, variety, veracity, and value - which distinguish big data technologies from traditional data management systems. In the context of medium and large enterprises, big data enables organizations to collect, process, and analyze vast amounts of information to improve innovation outcomes. The value of big data lies in its capacity to transform organizational decision-making, enhance operational efficiency, and drive innovation. Wamba et al., (2020) argue that enterprises leveraging big data analytics achieve a competitive advantage by uncovering market trends, automating operations, and predicting customer behaviour. Big data also helps medium and large enterprises navigate market

uncertainties and optimize innovation processes, which often involve high levels of unpredictability. Nevertheless, challenges exist, including privacy concerns due to the massive volume of data (Zuboff, 2019), potential legal and ethical issues arising from misuse of data, and the substantial financial investment required for infrastructure, analytics tools, and skilled personnel (Ghasemaghaei, 2021). Big data was operationalized across four dimensions: data collection, data processing and management, analytics capabilities, and data-driven decision-making. Data collection assessed the enterprises' ability to gather structured and unstructured information from sources such as customer interactions, social media, and transactional records (Wamba et al., 2020). Data processing focused on the capacity to clean, store, and manage large datasets efficiently. Analytics capabilities examined the range of methods and tools, including predictive and prescriptive analytics, used to generate insights (Chen et al., 2021). Finally, data-driven decision-making captured the extent to which medium and large enterprises leveraged big data insights to guide strategic innovation choices, thereby influencing their innovation outcomes. Collectively, these dimensions provided a comprehensive understanding of how big data is deployed and its impact on innovation within selected enterprises.

Big data has revolutionized innovation in organizations by supporting data-driven decisions, boosting efficiency, and discovering market opportunities. Big data analytics, as a key resource, enables product innovation, process improvement, and business model innovation (Wamba et al., 2020). Organizations' capabilities to leverage big data increasingly influences innovation outcomes-new products, process improvements, and new firm capabilities related to competitive advantage (Chen et al., 2021). Organizations that utilize big data effectively can better understand consumer behaviors, decrease costs in their supply chains, and predict important trends in the market to enhance innovation performance (Mikalef et al., 2019).

Innovation outcomes are the quantifiable effects of an organization's innovation activities. Innovation outcomes are new or improved products, processes, or services, and business models. Schumpeter (1934) called innovation outcomes to include the launching of new goods, a new method of production, and an expansion of the market. All three of these elements are of course very relevant and contribute to a firm's competitive advantage. Dodgson et al., (2018), defined innovation outcomes as advantages, either tangible or intellectual, that emerge at the intersection of research and development and the application of new knowledge while improving business performance and market position. Dodgson et al., (2018) defined innovation outcomes as productivity improvements, efficiency, and value-added, resulting from technological improvements, process improvement, or new ideas with business strategies. These definitions highlight that innovation outcomes can encompass more than product innovation, including alterations to service innovation, revising organizational activities, or efficiency in operations. (OECD, 2021).

Innovation outcomes are critical because they can improve firm performance, competitive advantage, and support economic growth. Dodgson et al., (2018) offered a comprehensive analysis of innovation management, such as the way in which businesses can effectively implement innovation strategies to achieve higher firm performance. The study emphasized

the alignment of innovation projects with organizational goals and the external environment. It also emphasized that good leadership, an innovative culture, and strategic utilization of technology progress are generally accountable for good innovation outcomes. Such observations hold significant importance for selected companies looking to improve their innovation ability and market position. According to Teece (2018), firms that invest in innovation can gain operational and financial performance advantages through product differentiation and service improvement. Big data analytics has risen to become an important enabler of innovation (Wamba et al., 2020), allowing firms to spot trends in the marketplace, enhance the customer experience or streamline operational processes. Innovation allows new jobs to be created, information to be disseminated, and economies to develop by supporting entrepreneurship and technological change (OECD, 2021). With the significant speed of digital transformation, and the increased prevalence of data-driven decision making, it is important to investigate the implications of big data on innovation as a means to better understand the ways organizations can leverage technology to facilitate success.

The measurable outcomes of innovation in this study were defined in terms of product innovation, process innovation, business model innovation, and market performance. First, product innovation was measured in terms of the number and quality of new or substantially improved products that a business had launched in some specific timeframe (Dodgson et al., 2018). Second, process innovation was measured in terms of the operational efficiencies, new production methods, and cost reductions generated as the result of big data analytics (Wamba et al., 2020). Business model innovation was defined as changes in value propositions, revenue streams and customer engagement based upon data-based insights. Market performance was measured in terms of changes in market share, customer satisfaction, and sales growth as a result of innovation initiatives (OECD, 2021).

Business enterprises in Nairobi County, including both medium and large firms, play a pivotal role in Kenya's economic growth by generating employment, fostering innovation, and enhancing competitiveness. These organizations operate across diverse sectors such as manufacturing, retail, (Information & Communication Technology (ICT), financial services, construction, and agribusiness, reflecting the dynamic commercial environment of the capital city (KNBS, 2023; KBA, 2021). Medium and large enterprises contribute significantly to Gross Domestic Product (GDP) and market innovation by introducing new products, improving operational efficiencies, and adopting advanced technologies (Financial Sector Deepening Kenya, 2024). Despite their strategic importance, these firms face challenges such as high operational costs, regulatory compliance demands, and uneven technological readiness, which can impede the effective adoption of innovative strategies and big data analytics. Addressing these constraints is crucial for sustaining their growth and maximizing their impact on Kenya's economic development. In this study, a select number of medium and large enterprises were chosen due to their active use of big data analytics and capacity for innovation. These firms, while varying in size, share characteristics such as workforce numbers and substantial annual turnover, positioning them to leverage data-driven strategies effectively. Their adoption of big data enables improved

decision-making, customer insights, operational optimization, and strategic responsiveness, thereby facilitating innovation in products, services, and processes (KNBS, 2023; OECD, 2022). George et al., (2021) and the Dynamic Capabilities Framework (Teece, 2018), which highlight leadership as a strategic capability that enhances sensing, adaptation, and long-term competitiveness. Examining these enterprises provides a comprehensive understanding of how technological readiness, leadership commitment, and organizational capabilities influence the innovation outcomes of data-driven strategies in Nairobi's competitive business environment.

Selected firms have a particular significant role in terms of supporting employment, innovation, and competitiveness in Kenya's economic development. However, despite having the potential, most enterprises cannot sustain innovation due to various challenges such as limited access to finance, adverse technological adoption, and poor use of data and data-driven decision-making (KIPPRA, 2022). Big data analytics is now a revolutionary tool for enhancing innovation outcomes, but its adoption and influence on selected businesses in Kenya are not well documented. While firms in developed economies leverage big data to inform product innovation, market intelligence, and operational efficiency (McAfee & Brynjolfsson, 2022), selected businesses in Nairobi are faced with numerous challenges such as high implementation costs, lack of skilled personnel, and data security concerns.

Organizations that effectively utilize big data can analyze consumer behavior, optimize supply chains, and predict market trends, thereby enhancing innovation performance. However, the extent to which big data analytics influences innovation outcomes varies depending on factors such as industry type, technological readiness, and organizational capabilities. Selected enterprises in Nairobi County play a significant role in Kenya's economic growth through contributions to employment, competitiveness, and innovation. Despite their potential, many of these enterprises face challenges in sustaining innovation due to limited access to finance, inadequate technological adoption, and suboptimal use of data in decision-making.

Conceptually, existing research establishes a link between big data analytics and firm innovation, highlighting its role in enhancing business intelligence, customer insights, and process efficiency (Wamba et al., 2020). However, most studies focus on large multinational firms with advanced technological infrastructure, leaving a gap in understanding how enterprises, particularly in Kenya, harness big data for innovation. Methodologically, previous studies have primarily employed quantitative approaches, focusing on statistical relationships while overlooking contextual factors influencing big data adoption (Ghasemaghaei, 2021).

The limited use of qualitative research in this area leaves a gap in understanding firms' lived experiences, challenges, and strategic decisions (Mikalef & Gupta, 2021). Empirically, most studies on big data focus on large corporations, with minimal research on enterprises in Kenya, particularly in Nairobi (Gachara, 2017). These studies largely emphasize adoption levels or firm performance outcomes, offering limited insight into the organizational capabilities such as leadership support, human capital readiness, data-driven culture, and governance mechanisms that enable analytics to drive innovation. Hence, this research study sought to answer how big data adoption influence

innovation outcomes in enterprises in Nairobi County, Kenya.

Literature review

This study is rooted in the Diffusion of Innovation (DOI) Theory and Dynamic Capabilities Theory. Diffusion of Innovation (DOI) Theory was originally suggested by Everett Rogers in 1962 to describe how new practices, ideas, and technologies get diffused in organizations and societies over time. Rogers (2003) later adapted the theory to highlight that innovation adoption occurs following a predictable pattern in response to various factors like relative advantage, compatibility, complexity, trialability, and observability. These, according to theory, are more likely to be adopted widely if they evidence clear benefits, are compatible with existing practices, are simple to use, can be piloted before full take-up, and whose impacts can be observed. In organisational settings, such as among selected enterprises, the DOI theory argues that the adoption rate and degree of technology depend on the perceived innovation benefit and readiness of the adopting organization. Here, the adoption of big data analytics relies greatly on how companies perceive its contribution towards enhancing decision-making, innovation, and competitiveness (Rogers, 2003).

The DOI theory is built on several basic assumptions about how innovation spreads within an organizational or social system. Firstly, adoption occurs in a series of steps - knowledge, persuasion, decision, implementation, and confirmation which determines whether an innovation is applied in practice (Rogers, 2003). Secondly, the theory suggests that adopters are placed in distinct categories such as innovators, early adopters, early majority, late majority, and laggards and each of them sets the rate and amount of adoption. Thirdly, diffusion is affected by the characteristics of an innovation as well as communication channels, social systems, and opinion leaders' influence within a network. These assumptions highlight that organisational readiness, technological awareness, and external social pressures affect the adoption performance. In the case of selected enterprises contemplating adoption of big data analytics, these assumptions emphasize the need to develop technological know-how, reducing the complexity of adoption, and leveraging peer networks to accelerate take-up and infusion of analytics-driven innovations.

Teece, Pisano, and Shuen introduced the Dynamic Capabilities Theory as an extension of the Resource-Based View (RBV) (Teece, 1997). While RBV emphasized the possession of valuable, rare, and inimitable resources as the foundation of long-term competitive advantage, it didn't pay adequate attention to hypercompetitive market conditions. Dynamic Capabilities Theory bridged this gap by emphasizing the importance of agility, flexibility, and continuous reconfiguration of resources in order to maintain competitiveness. Dynamic capabilities, Teece (2018) enable firms to sense opportunities, capture value, and reimagine business models as a result of environmental turbulence and technological discontinuities. It is particularly useful to firms working in complex and turbulent business environments since it focuses on how innovation continuity is driven through managerial processes and organizational learning. By prioritizing sensing, seizing, and transforming, the theory provides an account of how firms evolve strategically in volatile markets (Eisenhardt & Martin, 2000).

Dynamic Capabilities Theory is based on three assumptions that form the core of its organizational competitiveness model. First, firms must develop sensing capabilities that allow them to observe looming threats and opportunities through market intelligence, environmental scanning, and technological foresight (Teece, 2007). This allows them to remain attuned to early signals of change. Second, firms must possess seizing capabilities that enable them to mobilize and allocate resources effectively in a bid to capture identified opportunities and convert them into competitive advantage. This requires not only financial investment but also firm leadership commitment and strategic decision-making (Helfat & Peteraf, 2003). Third, the theory emphasizes transformational capabilities, with firms continuously reshaping and reforming their resources, processes, and structures to align with evolving market conditions. This ongoing regeneration ensures long-term performance and innovative viability. Together, these assumptions underscore the importance of flexibility and responsiveness in environments marked by technological turbulence and global competition.

Dynamic Capabilities Theory is relevant to the present research in that it presents a conceptual agenda for exploring means through which enterprises in Nairobi County can leverage big data analytics (BDA) in an attempt to enhance innovation performance. BDA is a dynamic capability since it enables firms to sense market evolution through real-time analysis, exploit opportunities by aligning resources to novel consumer requirements, and transform their innovation strategies through data-driven decision-making (Teece, 2018). This is aligned with the study variables, where big data analytics is the enabling mechanism and innovation outcomes are the organizational performance anticipated. Under changing competitive circumstances at a rapid pace, especially in developing economies, selected companies must rely on data-driven insights to remain agile and innovative. By linking BDA to dynamic capabilities, the study positions analytics not only as a technological tool but as a strategic enabler of sustainable innovation and long-term competitiveness.

Existing literature consistently shows that big data analytics (BDA) enhances innovation by improving decision-making, operational efficiency, and competitiveness (Pathak et al., 2025; Sivarajah et al., 2024). However, most studies are based in developed economies, limiting their applicability to regions with varying technological readiness. Meta-analyses (Aryal et al., 2020) establish a link between BDA and performance but overlook infrastructural and contextual differences. African studies (Joubert et al., 2021; Kgakatsi et al., 2024) note challenges such as limited skills and weak infrastructure but mainly examine SMEs or national readiness, offering little insight into sector-specific innovation dynamics among medium and large firms.

Kenyan evidence (Hersi, 2022; Mitieka, 2019) confirms the benefits of BDA but also highlights barriers like high adoption costs and weak data governance. Yet, these studies rarely explore how enterprises strategically use BDA to drive product and process innovation. Broader innovation literature (Hall et al., 2008; Dodgson et al., 2018) emphasizes innovation's role in firm growth but does not clarify how BDA shapes innovation mechanisms in African contexts. As recent analytics research (Darke, 2024; Lutfi et al., 2022) leaves sectoral and methodological gaps, a contextualized study is required to understand how medium and large

enterprises in Nairobi County operationalize BDA to enhance innovation outcomes.

Research Methodology

This study adopted a multiple case study design to explore how big data analytics drives innovation within selected enterprises. Case study research was appropriate because it enables an in-depth examination of complex, context-dependent phenomena where boundaries between the process and its environment are unclear (Yin, 2018). While a single case allows detailed investigation, multiple cases offer stronger analytical generalization by enabling cross-case comparisons and capturing variation across organizational contexts (Gustafsson, 2017). Although this approach is resource-intensive and poses risks of researcher subjectivity, credibility was strengthened through a clear audit trail, triangulation using interviews and documents, and ongoing reflexivity.

This study used purposive case selection, consistent with Yin's (2018) emphasis on gaining rich contextual understanding, to identify Nairobi County enterprises actively adopting big data analytics (BDA). Potential firms were drawn from Nairobi County Government Licensing registry and selected to ensure diversity across sectors and organizational contexts. A number of pre-requisites were required for selection. Firstly, eligible enterprises had used BDA for at least six months to guarantee adequate experience with analytics. A total of 12 firms were thus selected. This respondent selection approach aligns with guidance of Guest et al., (2006) that saturation is typically reached within 6–12 information-rich cases, enabling meaningful cross-case comparisons while remaining practical in terms of time and resources. Key informants such as managers, IT specialists, and innovation officers were chosen for their direct involvement in analytics-related decision-making.

Semi-structured interviews and document analysis was used as key data collection instruments in the research. Semi-structured interviews allowed for free-flowing conversations, enabling participants to give extensive information as well as allowing the researcher to probe further on key themes (Kvale & Brinkmann, 2015). An interview guide that has flexible but structured questions was used to offer consistency. Interviews were transcribed, member-checked, and coded using first-order concepts, with NVivo supporting organization and an 87% inter-coder agreement ensuring reliability. These codes were then developed into second-order themes on BDA capabilities, decision-making, governance, and innovation. Finally, themes were synthesized into aggregate dimensions that shaped the study's conceptual contributions. Trustworthiness was enhanced through peer debriefing and triangulation with documents such as analytics reports and strategy papers.

Data analysis was undertaken using content analysis to derive themes and conclusions. The study applied the Gioia Methodology to analyze qualitative data, allowing insights on big data analytics adoption and innovation to emerge inductively (Gioia et al., 2012). The findings were categorized into first-order concepts (informant-centered), second-order themes (researcher-centered), and aggregate dimensions (theoretical abstraction). This approach enhanced analytical rigor by illustrating the link between raw empirical evidence and broader theoretical insights.

Analysis and Results

The study involved twelve selected enterprises located in Nairobi County that had been utilizing big data analytics for a minimum of six months. A representation of the respondents is presented in Table 1.

Table 1: Profile of the Respondent Firms

Industry Sector	No. of Employees	Key Informant Position	Gender	Ownership Structure	Years in Operation
Manufacturing	120	Head of IT	Male	Family-Owned	12
ICT	95	Innovation Officer	Female	Privately-Owned	8
Logistics	140	Senior Executive	Male	Family-Owned	15
Retail	80	IT Manager	Female	Partnership	10
Financial Services	150	Innovation Manager	Male	Privately-Owned	18
ICT	110	Senior Executive	Female	Privately-Owned	7
Manufacturing	135	Head of IT	Male	Family-Owned	20
Retail	60	Innovation Officer	Female	Partnership	6
Logistics	100	IT Manager	Male	Privately-Owned	11
Financial Services	130	Senior Executive	Female	Family-Owned	16
Manufacturing	145	Head of IT	Male	Family-Owned	14
ICT	75	Innovation Officer	Female	Privately-Owned	9

The profile indicates relevant company traits; sector, ownership arrangement, and years in operation. Differences across the firm profiles emphasize the heterogeneous composition of selected enterprises in Nairobi County and also assist to explain differences in adoption and usage of big data technologies by the organizations. The firms were spread across a range of industry areas or sectors including, but not limited to, manufacturing, ICT, logistics, retail, as well as financial services. The diversity in this selection was meant to capture differences in use based on the different contexts of organizations employing big data analytics. The majority of firms reported having 150 and above employees. Aside from the different focus in industries, the firms shared a commitment to innovation and digital transformation, which

made them applicable to the objectives of the study.

Organizations in Nairobi primarily adopted big data analytics to enhance customer understanding, optimize operations, and drive product and service innovation. Adoption typically began by addressing strategic problems, such as inventory misalignment, logistical inefficiencies, or declining customer satisfaction. As one retail manager noted, "We realized we were stocking the wrong items at certain branches. Big data helped us align inventory with real-time demand trends". Similarly, a fintech participant explained, "We analyze repayment patterns and mobile usage to build customer credit profiles and reduce loan default risks", while an ICT firm used analytics to improve service support effectiveness. Customer-driven insights were a common motivation, exemplified by a consumer goods manager: "By understanding customer feedback, purchase histories, and trends based on seasons, we can more confidently develop new products." Firms employed tools like Power BI, Tableau, and CRM platforms, but success depended on leadership, data literacy, and organizational readiness. Barriers arose where data existed but lacked actionable use: "We collect a lot of data, but no one really knows how to use it to drive decisions. It just sits in spreadsheets". Effective adoption required strategic alignment, training, and a culture of data-driven innovation, consistent with DOI theory.

A key theme that emerged was the imbalance between firms' advanced technological infrastructure and their limited human capital readiness for big data work. Although many enterprises had invested in cloud systems, Enterprise Resource Planning (ERP) tools, and high-performance computing, respondents noted persistent skill gaps. As one participant explained, "We've put a lot into building our digital platforms, but we still depend on external consultants for deeper analytics" (Respondent 4, Logistics). Similar concerns arose in retail, where one manager noted, "Interpreting the real-time data for strategic planning remains a challenge" (Respondent 1, Retail). Firms showing stronger progress actively invested in talent development through partnerships and internal training, with one respondent sharing, "Our in-house modules in Structured Query Language (SQL), Python, and Power BI have dramatically improved how our team engages with BI tools" (Respondent 7, Fintech). Leadership support further reduced integration challenges, as reflected by a manufacturing respondent: "Our Chief Executive Officer personally approved a phased digital upskilling program" (Respondent 2, Manufacturing). Others stressed the strategic value of talent, stating, "Technology alone won't solve problems… if you don't have the right people interpreting the data, you're still flying blind" (Respondent 5, Fast Moving Consumer Goods (FMCG). These findings align with the Resource-Based View (Barney, 1991), highlighting human capital as a critical, hard-to-imitate capability necessary for translating data infrastructure into meaningful business insights.

Leadership support proved essential to the successful adoption of big data analytics among selected enterprises in Nairobi, with proactive, innovation-driven executives accelerating digital transformation and enabling resource commitment to analytics initiatives. Leaders acted as catalysts for cultural change, fostering collaboration and experimentation—illustrated by one participant who noted, "Our leadership doesn't just authorize tech projects—they immerse themselves in our analytics discussions

and push us to extract deeper insights" (Respondent 5, ICT). Organizations with open, collaborative cultures operationalized data more effectively, while rigid or risk-averse firms underused their capabilities. As another respondent emphasized, "Success for us wasn't just the software—it was having leadership that inspired all departments to care about what the data was saying" (Respondent 8, Retail). Leadership also strengthened accountability by integrating analytics into performance systems, with one manager explaining, "Every team now knows their KPIs come straight from analytics dashboards—we can't operate on guesswork anymore" (Respondent 1, ICT Services). These findings align with Wamba et al., (2020), George et al., (2021), and the Dynamic Capabilities Framework (Teece, 2018), which highlight leadership as a strategic capability that enhances sensing, adaptation, and long-term competitiveness.

Big data analytics significantly improved innovation outcomes among selected Nairobi firms by accelerating product development, enhancing service efficiency, and strengthening responsiveness to market shifts. Participants emphasized a shift from intuition to evidence-based decisions, with one noting, "Previously, we depended heavily on instinct and assumptions. Now, our product launches are informed by real-time feedback and analytics" (Respondent 3, Manufacturing). Firms reported gains such as accurate forecasting, streamlined inventory, and dynamic pricing, supported by real-time dashboards -"Our dashboards give us real-time visibility into consumer behavior, allowing us to tailor promotions instantly" (Respondent 6, Retail). These insights align with Akter et al., (2020) and Mikalef et al., (2019), who highlight analytics-driven agility. The strongest innovation effects appeared in firms with leaders who cultivated data-driven cultures. As one executive explained, "We expect every unit to justify their plans with data… Innovation isn't just a slogan here" (Respondent 2, ICT). Consistent with Dynamic Capabilities Theory (Teece, 2018), such leadership enabled continuous learning, rapid adaptation, and stronger innovation performance. Overall, embedding big data into strategy and operations - reinforced by supportive leadership - emerged as a powerful driver of sustained innovation and competitiveness.

Data Structure

The data structure that was used in the research is shown in Figure 1.

Figure 1: Data analysis through data structure

The analysis revealed that firms adopted big data to solve practical business challenges such as stock-demand mismatches, repayment risks, and inefficient service monitoring. These first-order issues were grouped into second-order themes of customer-centric adoption, operational efficiency, real-time monitoring, and tool integration challenges. Collectively, they formed the aggregate dimension of Strategic Adoption of Big Data. This finding demonstrates that adoption was not driven by technology for its own sake but by a clear need to enhance customer satisfaction, streamline operations, and make more informed decisions. However, while successful firms aligned analytics with customer-focused strategies, others struggled with integration barriers, highlighting that strategic alignment and organizational readiness determined how effectively big data translated into value.

Technology and Human Capital Readiness

The findings for the theme on technology and human capital readiness are presented in Figure 2.

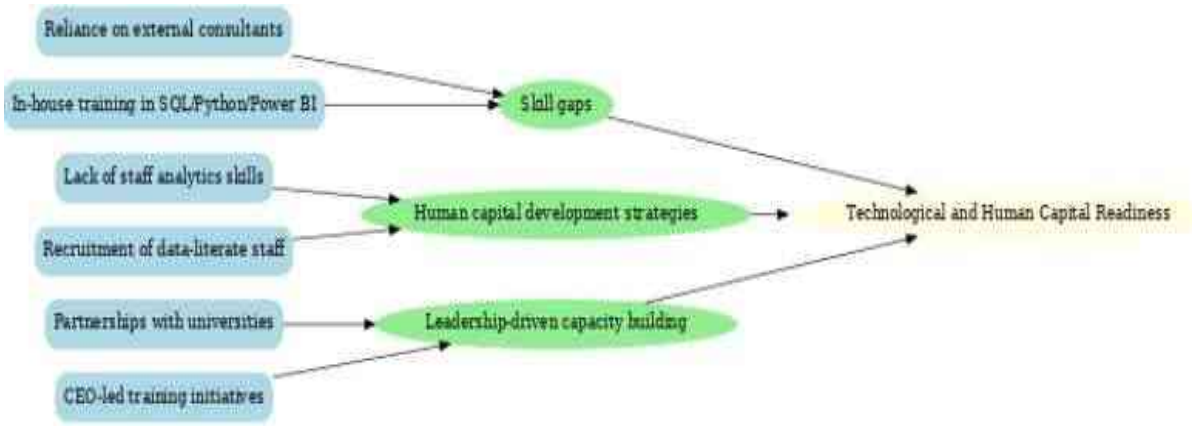

Figure 2: Technological and Human Capital Readiness

Firms frequently cited reliance on external consultants, low staff analytics capacity, and rapid digital transitions as major obstacles to effective data utilization. These first-order concerns reflected broader second-order themes of skill gaps, uneven human capital development strategies, and leadership-driven capacity building. Together, they highlighted the aggregate dimension of Technological and Human Capital Readiness. The findings suggest that while many firms had invested in modern IT infrastructure, their ability to generate value hinged on staff training and digital literacy. Companies that partnered with universities, offered in-house programs in SQL, Python, and Power BI, or recruited analytics-savvy staff were better positioned to extract insights. Thus, bridging the skills gap through deliberate human capital investments was essential for data-driven competitiveness.

Organisational Capabilities and Leadership

The findings on the theme of organizational capabilities and leadership are presented in Figure 3.

Figure 3: Organisational Capabilities and Leadership

The analysis emphasized the centrality of leadership in guiding data-driven transformation. Informant concepts such as leadership immersion in analytics, hierarchical resistance, cross-team collaboration, KPI integration, and executive sponsorship formed second-order themes of leadership involvement, organizational culture, and accountability structures. Together, these yielded the aggregate dimension of Leadership-Driven Organizational Capabilities. Firms with proactive, innovation-oriented leaders demonstrated faster adoption, deeper integration, and stronger alignment of analytics with business objectives. In contrast, rigid or risk-averse organizational cultures underutilized data despite having advanced tools. The evidence underscores that leadership is not just supportive but catalytic—shaping culture, accountability, and organizational learning. Strategic leadership transformed analytics into a shared capability, enabling adaptability and positioning firms for sustainable competitive advantage.

Innovation Outcomes

Findings on Innovation Outcomes are presented in Figure 4

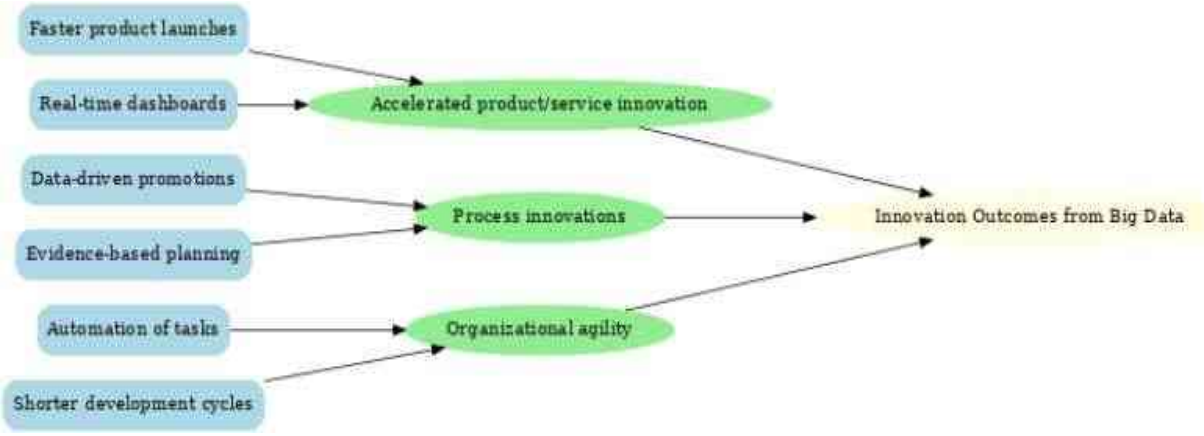

Figure 4: Innovation Outcomes

The adoption of big data analytics by selected firms in Nairobi County has yielded notable innovation outcomes, particularly in expediting product development and enhancing service efficiency. Participants consistently attributed their improved responsiveness to evolving

customer preferences and shifting market trends to data-driven insights. Another major pattern that emerged was the firms' improved responsiveness to market shifts and enhanced decision-making processes due to big data insights. Companies described benefits such as more accurate forecasting, streamlined inventory practices, and dynamic pricing models as direct results of leveraging real-time analytics.

Data from respondents showed how analytics directly supported innovation by enabling faster product launches, evidence-based promotions, automation, and real-time decision-making. These first-order concepts were synthesized into second-order themes of accelerated product/service innovation, process innovation, and organizational agility. The aggregate dimension of Innovation Outcomes from Big Data illustrates that adoption went beyond efficiency gains to actively drive market responsiveness and creativity. Firms reported shorter product development cycles, minimized risks, and more accurate forecasting. Dashboards allowed real-time visibility into consumer behavior, fostering agility and experimentation. Ultimately, innovation outcomes were strongest where leadership reinforced a culture of data-driven planning. This alignment positioned firms not only to streamline operations but also to achieve radical and incremental innovations that strengthened competitiveness.

Regulatory and Ethical Considerations

Findings on Regulatory and Ethical Considerations are presented in Figure 5.

Figure 5: Regulatory and Ethical Considerations

Respondents highlighted compliance with the Data Protection Act 2019, lack of technical know-how, and ethical dilemmas such as algorithmic bias as key concerns. These first-order issues were grouped into second-order themes of data governance, compliance challenges, and ethical responsibility. Together, they formed the aggregate dimension of Regulatory and Ethical Preparedness. The findings indicate that regulations shaped firms' data practices by pushing them toward better governance and transparency, though compliance costs were burdensome for smaller firms. Beyond regulatory mandates, respondents stressed the importance of fairness, consent, and responsible use of analytics to maintain stakeholder trust. Companies prioritizing ethical standards gained reputational benefits and

consumer loyalty, while those struggling with compliance risks faced constraints on innovation and competitiveness.

Discussions

Thematic analysis revealed that big data analytics plays a transformative role in fostering innovation outcomes among selected enterprises in Nairobi County. Firms reported tangible benefits such as accelerated product development, enhanced customer insights, and improved operational efficiency. However, the extent of these benefits was largely dependent on organizational readiness, including infrastructure, data talent, and strategic alignment. Leadership emerged as a critical enabler, with visionary, data-literate executives driving adoption and cultivating a culture of experimentation and agility. Moreover, the analysis highlighted that contextual factors such as regulatory compliance and ethical considerations significantly influenced adoption patterns.

The findings of this study strongly align with Rogers' Diffusion of Innovation (DOI) Theory, particularly in explaining the patterns of adoption among selected enterprises. According to DOI, the adoption of any innovation depends on five attributes: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). Firms in Nairobi County demonstrated accelerated adoption of big data analytics when they perceived clear relative advantages such as enhanced decision-making, customer insights, and operational efficiency. Similarly, compatibility with existing organizational structures and digital strategies played a role in determining adoption rates. Firms with prior investments in digital infrastructure found integration of big data less complex, thereby reinforcing Rogers' assertion that innovations diffuse faster when perceived complexity is low. However, firms lacking technical talent or infrastructure experienced adoption delays, highlighting the theory's relevance in contextualizing barriers. Thus, DOI provides a robust framework for understanding why certain enterprises in Nairobi embrace big data more readily than others.

Beyond adoption patterns, the findings also resonate with the Dynamic Capabilities Theory, which emphasizes the importance of agility, adaptability, and ongoing resource reconfiguration for sustaining competitive advantage (Teece et al., 1997). Enterprises that successfully harnessed big data were those able to develop sensing capabilities through continuous environmental scanning and market intelligence. For instance, firms that leveraged customer data to detect emerging trends were better positioned to tailor product development strategies in real time. The study also revealed the importance of seizing capabilities, as organizations that strategically invested in data infrastructure and analytics talent effectively capitalized on identified opportunities. Finally, transformational capabilities were evident in enterprises that reorganized business models around data-driven decision-making. These findings support Teece's (2018) argument that dynamic capabilities are essential for organizations to thrive in volatile, technology-driven environments.

Big data adoption among selected firms in Nairobi County was primarily driven by the need to enhance customer understanding, streamline operations, and foster innovation. Leadership support and organizational culture have been consistently validated in empirical studies as foundational determinants of big data adoption. The evidence from Nairobi's selected firms mirrors findings by Akter et al., (2021),

who established that executive involvement significantly strengthens firms' capacity to leverage analytics for strategic advantage. Similarly, Mikalef et al., (2020) found that leadership commitment directly influences how organizations transform analytics capabilities into tangible innovation outcomes, particularly in resource-constrained environments. Recent research by Maroufkhani et al., (2022) also demonstrated that firms with transformational leaders are more likely to foster a culture of openness and cross-functional collaboration, enabling the translation of big data insights into actionable strategies. These studies reinforce the observation that leadership not only legitimizes technological investments but also embeds a learning-oriented culture that minimizes resistance to change and maximizes the operationalization of analytics.

Moreover, recent empirical findings underscore the role of leadership in integrating data-driven practices into performance management and accountability frameworks. For instance, Papadopoulos et al., (2020) reported that enterprises that align big data analytics with Key Performance Indicators (KPIs) achieve stronger decision-making efficiency and improved innovation agility. Similarly, Bumblauskas et al., (2020) emphasized that embedding analytics into strategic planning promotes long-term sustainability by linking data insights directly with measurable organizational outcomes. These findings are consistent with the Nairobi case, where firms that tied analytics to performance indicators enhanced transparency, accountability, and institutional learning. Notably, Alharthi et al., (2023) argue that leadership-driven governance mechanisms, such as structured KPI integration and data stewardship, are crucial for navigating both competitive and regulatory landscapes. Collectively, these empirical insights confirm that leadership and organizational capabilities remain indispensable drivers of big data's transformative impact across diverse contexts.

The innovation outcomes reported by selected firms in Nairobi County align closely with broader empirical evidence that links big data analytics to organizational agility, efficiency, and customer-centric innovation. For instance, studies indicate that data-driven firms are more capable of detecting emerging consumer needs and responding with timely, targeted products and services (Gupta & George, 2020). This resonates with findings from respondents who described accelerated product development and reduced risks in market entry due to analytics-based decision-making. Similarly, research in comparable emerging economies shows that firms leveraging big data achieve superior market responsiveness through enhanced forecasting and inventory management practices (Alharti et al., 2021). The Nairobi firms' experiences of operational cost reduction and service improvement through analytics-driven automation parallel these global trends, underscoring the universality of big data as a driver of process innovation.

Firms in Nairobi County reported that regulatory compliance, particularly with the Kenya Data Protection Act of 2019, directly shaped their capacity to adopt and utilize big data responsibly. These findings align with empirical studies in other developing economies that highlight compliance as both a catalyst and barrier to innovation. For example, Waweru and Wanyoike (2021) observed that firms in Kenya with strong data governance frameworks were able to leverage compliance as a source of competitive advantage, building consumer trust and institutional legitimacy. Similarly, studies conducted in South Africa and Nigeria show that

organizations with advanced compliance structures often enjoy smoother adoption of analytics-driven strategies (Okeke & Adeyemi, 2020). However, resource-constrained enterprises in Nairobi echoed the concerns raised by Karanja and Gikonyo (2022), who found that SMEs often struggle with the costs of legal adherence, limited digital infrastructure, and inadequate expertise. This suggests that while regulation provides a necessary safeguard for consumer rights, its success as an enabler of innovation depends largely on the internal capabilities of the firm.

Conclusions

The study concludes that the adoption and usage of big data among selected enterprises in Nairobi is progressing, albeit at varied levels of maturity. Firms that embraced data analytics early demonstrated more robust integration across departments and operations. Big data was primarily used for customer insights, market trend analysis, and operational efficiency. However, challenges such as high implementation costs, limited infrastructure, and inadequate in-house expertise hindered deeper adoption. Firms with clear data strategies and collaborative data cultures reported higher returns from their investments. The findings affirm that big data is no longer a luxury but a necessity in modern enterprise competitiveness. Leadership proved crucial, as data-literate executives aligned analytics with strategy and fostered data-driven cultures, enabling dynamic capabilities and organizational learning. BDA positively influenced innovation outcomes by accelerating product development, enhancing customization, and improving decision quality, especially when insights were embedded across decision levels. However, innovation benefits depended on firms' absorptive capacity. Regulatory and ethical compliance, particularly with Kenya's Data Protection Act (2019), further shaped outcomes by strengthening legitimacy, reducing risks, and supporting responsible, sustainable innovation.

The government, in collaboration with industry associations, should invest in nationwide digital upskilling programs targeting Micro, Small and Medium Enterprises (MSMEs). Subsidized training in data science, cybersecurity, and analytics should be prioritized to narrow the digital divide. Policymakers should streamline existing data regulations and offer sector-specific guidelines to reduce compliance ambiguity. This includes developing simplified compliance toolkits for MSMEs and incentivizing adherence through recognition programs or tax benefits. To address resource gaps, the government should foster Public Private Partnerships (PPPs) that support innovation hubs, shared analytics infrastructure, and pilot programs in high-impact sectors like agriculture, fintech, and retail. These partnerships can accelerate learning and scale best practices. Regulatory bodies should lead in setting standards for fairness, transparency, and accountability in data use. Policy frameworks should emphasize consumer rights, algorithmic accountability, and mechanisms for redress in case of data misuse.

Key recommendations from the research findings include**;** firms should craft comprehensive digital transformation roadmaps that integrate big data analytics across all departments - from marketing and operations to finance and customer service. This includes investing in interoperable infrastructure and data analytics platforms that allow seamless information flow across units. Enterprises should build internal capacity through continuous professional development programs focused on data literacy, analytics tools, and

digital decision-making. Establishing cross-functional data teams and encouraging innovation sandboxes can catalyze cultural shifts toward data-centric operations. MSMEs should implement leadership development programs that equip executives and mid-level managers with skills in agile project management, digital ethics, and innovation leadership. Leaders should be visible champions of analytics initiatives, setting Key Performance Indicators (KPIs) and aligning teams toward data-driven goals. To drive innovation and responsiveness, firms must institutionalize the use of analytics in strategic planning, product development, customer engagement, and performance monitoring. This includes setting up structured feedback loops between data teams and operational staff. Organizations should establish robust data governance frameworks aligned with Kenya's Data Protection Act, including regular audits, ethical review boards, and mandatory staff training. Responsible data practices not only build trust but also provide competitive differentiation. Scholars should undertake empirical studies examining how socio-cultural, institutional, and sectoral contexts in Kenya influence the adoption and impact of big data analytics. Comparative studies across counties and industries are particularly needed. Academic institutions should revise business, IT, and data science curricula to reflect industry needs. Programs should emphasize applied analytics, real-time case studies, and collaboration with MSMEs on capstone projects.

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Conflicts of Interest

No conflicts of interests in the research.

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