Digitalization

Paul A. Adekunte[1], Matthew N. O. Sadiku[2], Janet O. Sadiku[3]

[1]International Institute of Professional Security, Lagos, Nigeria
[2]Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX, USA
[3]Juliana King University, Houston, TX, USA

ABSTRACT

Digitalization is the process of leveraging digital technologies to transform business processes, operations, and workflows, to drive and enhance efficiency, productivity, and innovation. Digitalization goes beyond mere digitization, which is the conversion of analog data into digital formats, by the use of digital tools to automate tasks, improve decision-making, and generate value (added value) for businesses and customers. Furthermore, digital transformation is a cultural shift which often involves reimaging business models and customer interactions, as a process that requires a combination of technology innovation, organizational agility, often leading to fundamental shifts in the way businesses operate, compete, and grow in the digital age. The paper looks at digitalization, digitization, and digital transformation cum the pros and cons, and as well as their benefits to humanity.

KEYWORDS: Digitalization, digitization, digital transformation, technology, COVID-19, artificial intelligence (AI), Internet of Things (IoT), blockhain, cybersecurity, automation, Big Data, digital twin

INTRODUCTION

Organizations today are known to face increased pressure to adapt to the digital world, driving businesses to evaluate strategies like digitalization, digitization, and digital transformation, as shown in Figure 1. These terms are often used interchangeably, but they represent distinctly different processes with varying levels of complexity and strategic focus. However, each strategy serves a unique purpose, starting from the foundational act of converting analog data into digital formats to completely reshaping business models for long-term growth. The above concepts must be well understood in order to make informed decisions tailored to organizational priorities [1].

There is the question of what do vehicle makers like Rosenbauer, logistics company DB Schenker, compressor manufacturers such as Bauer, elevator producers like ThussenKrupp, and Hagleitner, a hygiene goods corporation, have in common? They all use the potential of digitization to offer customers smarter and faster services and actively shape their business model's digital transformation (DT), as shown in Figure 2. DT affects all sectors of society, in particular economies. It also as well opens new networking possibilities and enables cooperation between different actors, who, for example exchange data and thus initiate processes. Hence, in this context, the DT of business model plays an essential role because business models' individual elements that can be digitally transformed [2].

HISTORICAL BACKGROUND

The concise historical background on digitization, digitalization, and digital transformation are as presented below [3]:

1. **Digitization**: Digitization is defined as the process of converting analog information into digital formats. It is the foundational step toward digital technologies.

Historical Background:
➢ 1950s-1970s: This was the advent of computers initiated digitization. Libraries and governments began converting physical records into digital formats for storage and processing.
➢ 1980s-1990s: The rise of personal computing and scanning technologies allowed broader digitization of text, images, and audio.

➢ 2000s-Present: Mass digitization of archives, books (e.g., Google Books), and media became common, enabling digital storage and retrieval.

2. **Digitalization:** Digitalization refers to the use of digital technologies to change business processes and improve productivity [4, 5]:

Historical background:
➢ 1990s-2000s: As the internet grew, companies started to digitize workflows (e.g., online forms, email communication) and automate processes.
➢ 2010s: Widespread adoption of ERP systems, CRM platforms, and cloud computing marked deeper integration of digital tools in operations.

3. **Digital Transformation**: Digital transformation is defined as a broader, strategic change that leverages digital technologies to transform business models, customer experiences, and organizational culture [6-8]:

Historical Background:
➢ 2010s-Present: This is driven by advances in AI, IoT, big data, and mobile technology, with businesses rethinking their entire value chains. Digital transformation now affects not only business operations but also customer engagement, product design, and marketing strategies.
➢ COVID-19 Pandemic (2020): This led to accelerated digital transformation globally, hence pushing remote work, e-commerce, and services adoption.

BENEFITS OF DIGITALIZATION

Digitalization offers numerous benefits to man, which includes [9-12], as shown in Figures 3, 4 and 5:

1. Increased efficiency
➢ Automates manual tasks, reducing time and effort required to complete tasks.
➢ Streamlines business processes, freeing up employees to focus on more valuable activities.
➢ It enables quicker turnaround times and faster decision-making.

2. Improved collaboration and communication
➢ It enables real-time collaboration and communication among team members.
➢ Fosters innovation and collective problem-solving.
➢ Removes friction from document collaboration, allowing multiple users to work together simultaneously.

3. Enhanced data management
➢ Enables quick access to information, enhancing decision-making processes.
➢ Facilitates timely responses to market changes.

➢ It allows for better data analysis and insights, leading to informed decision-making.

4. Cost reduction
➢ Reduces the costs associated with manual processes and physical infrastructure
➢ Saves time and resources by minimizing errors and rework.
➢ Enables long-term cost savings through more efficient processes and reduced maintenance costs.

5. Increased agility and responsiveness
➢ It enables businesses to quickly respond to changing market conditions and customer needs.
➢ It allows for rapid adaptation to new developments and opportunities.
➢ It enhances competitiveness through innovation and rapid adaptation to market changes.

6. Enhanced customer experience: Digitalization offers personalized experiences, quicker responses, and tailored solutions, thereby boosting customer satisfaction.

7. Faster time-to-market: Enables businesses to react faster to market changes and roll out products faster than competitors.

8. Improved resource management: Consolidates company resources, reducing overlap between vendors and improving overall efficiency.

9. Increased profitability: Improves efficiency and profitability for companies, with 80% of organizations reporting increased profits after digital transformation.

10. Better sustainability: It can help move revenue streams via improved sustainability by reducing waste and promoting more environmentally friendly practices. By digitizing processes and reducing the need for paper and other physical materials, businesses can reduce their impact on the environment and promote sustainable practices.

11. Increased accessibility regardless of location.

12. Broader access to information and education – Digital platforms and the internet provide access to a vast repository of knowledge, democratizing education and enabling individuals to learn and develop new skills at their own pace.

13. Data-driven insights – This leads to gaining valuable insights into customer behavior, market trends, and operational performance that would result to more informed decision-making and improved strategies.

14. New revenue streams and business models – It opens up new avenues for businesses to create and offer innovative products and services, explore new markets, and build stronger customer relationships.

15. Improved sustainability – It can contribute to a more sustainable future by enabling energy efficiency, promoting renewable energy, and facilitating waste reduction.

16. Enhances global connectivity and collaboration – Enables businesses and individuals to collaborate and interact across geographical boundaries, promoting economic growth and cultural exchange.

17. Empowerment of individuals and businesses.

ROLES OF AI, IoT, DIGITAL TWINS AND BLOCKCHAIN IN DIGITALIZATION

1. Artificial intelligence (AI): Enabler of smart automation and insights:-

AI enhances digitalization by automating tasks, enabling predictive analysis, and supporting decision-making processes. Its key benefits are in the areas of predictive maintenance in manufacturing and smart cities, personalized services in e-commerce and healthcare, as well as automated customer support via chatbots [13, 14], as shown in Figures 6 and 7.

2. Internet of Things (IoT): Data backbone of digitalization:-

IoT connects physical devices to the internet, enabling real-time data collection and smarter infrastructure. The key benefits are: real-time monitoring in agriculture, logistics, and health; automation of homes, factories, and urban infrastructure (smart cities) and; enhanced operational efficiency through sensor data [15, 16], as shown in Figure 8.

3. Blockchain: Trust and transparency in digital transactions:-

Blockchain introduces decentralized, tamper-proof data storage, crucial for secure and transparent digital interactions. Some of its key benefits include: secure digital identity, and authentication systems; transparent supply chains and logistics and; fraud prevention in finance and governance [17, 18], as shown in Figure 9.

4. Digital twins:

This plays a significant role in digitalization by enabling businesses to create virtual representations of physical objects, systems, or processes. This technology has various applications across industries, including: predictive maintenance, operational efficiency, improved decision-making, enhanced innovation, and customer experience [19]. A requirement of a digital project twin (or digital twin of the project) is the representation of data from information systems around the project lifecycle management (PLM) with a focus from the formation idea through to the use phase, as shown in Figure 10.

DRAWBACKS OF DIGITALIZATION

Digitalization has several drawbacks that affect individuals, organizations, and the society as a whole. Some of the key drawbacks or disadvantages include [20-23]:

Social and economic drawbacks:

➢ Digital divide: Digitalization can widen the gap between developing and developed countries, as well as between people with access to technology and those without, as shown in Figure 11. This can lead to unequal opportunities and social exclusion.

➢ Job displacement and inequality: Certain jobs can be replaced by automation and AI, particularly those jobs requiring low to medium skill levels, thereby deepening income inequality and creating economic imbalances, as shown in Figure 12.

➢ Biased decision-making: In this case, AI algorithms can perpetuate biases, posing serious issues in terms of social justice and equity.

Environmental and health drawbacks [20, 21]:

➢ Environmental deterioration: The production, use, and disposal of digital technologies can harm the environment, hence contributing to climate change and resource depletion.

➢ Reduction of physical health: The excessive use of digital technologies can lead to bodily illnesses, diseases, or malfunction.

➢ Increased stress and burnout: Being constantly online and the pressure to adapt to innovation can threaten employees' psychological and physical wellbeing.

Technological and organizational drawbacks [20-23, 26, 27]:

➢ Complexity: Digitalization involves complex technologies that require advanced technical expertise, making it difficult for non-technical users to interpret and understand data.

➢ Technological infrastructure and integration/Legacy systems: Digitizing data often requires upgrading legacy systems, which can be time-consuming and costly.

➢ Overdependence on technology: Digitalization makes us heavily reliant on technology, disrupting businesses and causing losses in case of system failures or cyber attacks, and as well as leading to vulnerabilities in critical infrastructure and systems.

➢ Cybersecurity risks and privacy: Digitalization increases the risk of cyberattacks, data breaches, and privacy violations, compromising sensitive information.

OVERCOMING THE CHALLENGES FACING DIGITALIZATION

As transformative as digitalization may be, it also presents several challenges as enumerated above across industries. These include among others technological barriers, cybersecurity risks, resistance to change, and need for new skills. The key strategies to overcoming these hurdles are as outlined below:

1. Technological infrastructure and integration [28, 29]:

Challenge: Many organizations struggle with outdated IT systems and the complexity of integrating new digital tools with legacy infrastructure.

Solution:
➢ The adoption of cloud computing and scalable platforms to modernize infrastructure.
➢ Implement agile methodologies to facilitate phased integration and reduce disruption.

2. Cybersecurity and data privacy [30, 31]:

Challenge: The increasing use of digital connectivity leads to higher vulnerability to cyberattacks and data breaches.

Solution:
➢ Develop a robust cybersecurity framework using multi-layered defenses.
➢ Comply with international data protection laws (e.g., GDPR, CCPA).

3. Cultural resistance and change management [32, 33]:

Challenge: Employees may resist digital transformation due to the fear of job displacement or lack of digital literacy.

Solution:
➢ There is the need to implement change management programs focused on communication and training, as shown in Figure 13.
➢ Encourage a culture of innovation through leadership and incentives.

4. Skills gap and talent shortage [34, 35]:

Challenge: There is growing mismatch between available workforce skills and those needed for digital roles.

Solution:
➢ Need to invest in continuous learning, reskilling, and upskilling programs.

➢ Collaborate with educational institutions and tech partners.

5. Financial constraints [36, 37]:

Challenge: High initial costs of digital transformation can be a deterrent, especially for SMEs.

Solution:
➢ Leverage government subsidies and digitalization grants.
➢ Start with small-scale pilots to demonstrate ROI before scaling.

CONCLUSION

Conclusively, AI, IoT, and Blockchain collectively drive digital transformation by automating processes, enhancing data flows, and ensuring secure interactions. Their synergy leads to smarter, more efficient, and trustworthy systems across sectors like healthcare, logistics, finance, education, and governance. Overall, digitalization has the potential to drive significant benefits, but it requires careful consideration of the challenges and opportunities it presents.

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Figure 2. Digital-transformation

Source:https://www.google.com/search?sca_esv=e8
33def03aa227c2&sxsrf=AE3TifNz49lwid-5brENy-
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Figure 1. Digitization

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Figure 3. Digital data

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Figure 4. Digital media
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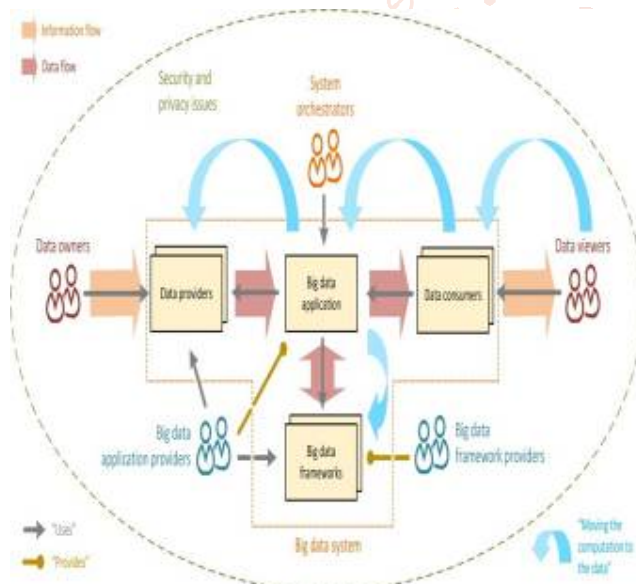
Figure 5. Big Data
Source:
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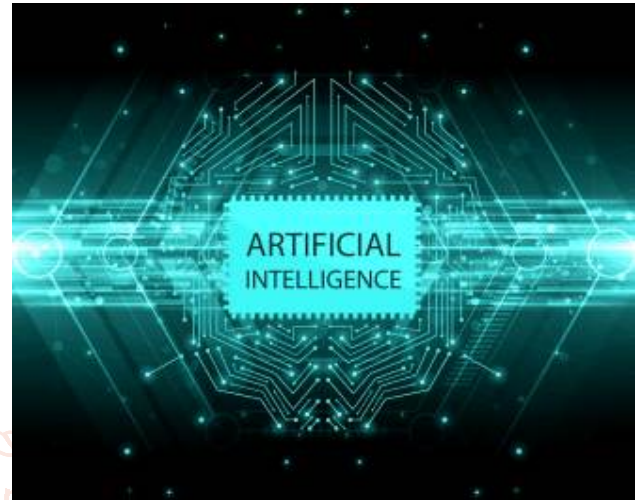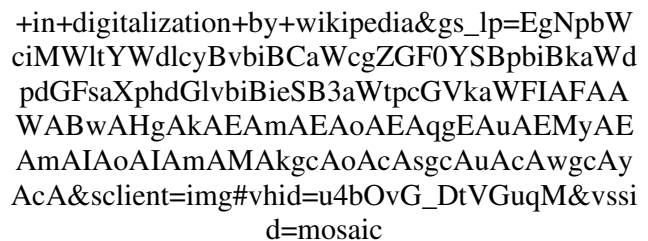AcA&sclient=img#vhid=u4bOvG_DtVGuqM&vssi
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Figure 6. Artificial Intelligence
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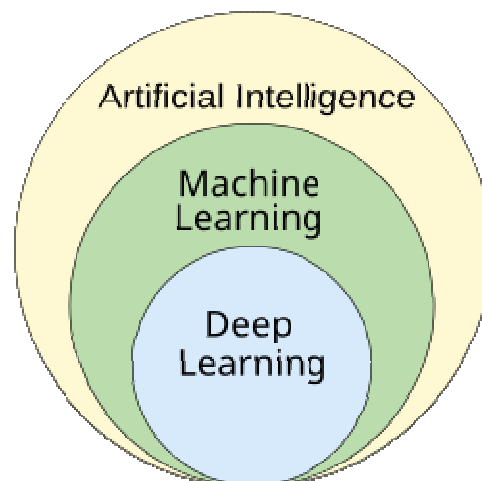4QtKgLegQIFBAB&biw=1036&bih=539&dpr=1#
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Figure 7. Artificial intelligence
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Figure 8. Internet of things

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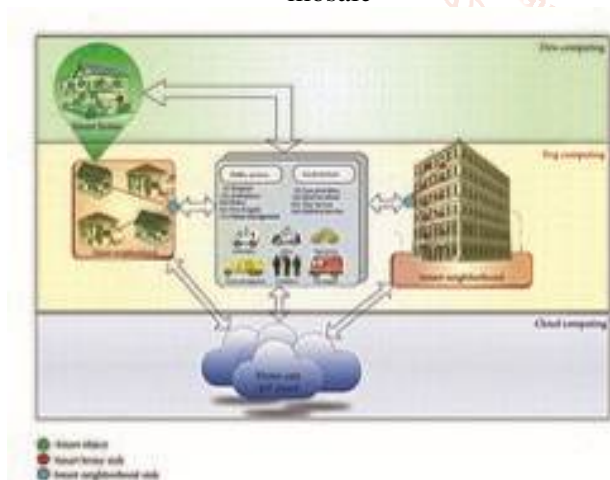A&sclient=img#vhid=UOU4GJw_nJZpVM&vssid
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Figure 9. Government by algorithm

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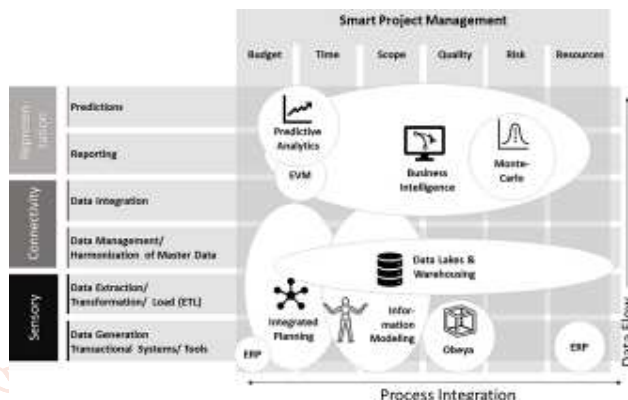Hw&sclient=img#vhid=6VP846C2VrXisM&vssid
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Figure 10. Digital project twin

Source:https://www.google.com/search?q=images+
on+digital+twins+in+digitalization+by+wikipedia&
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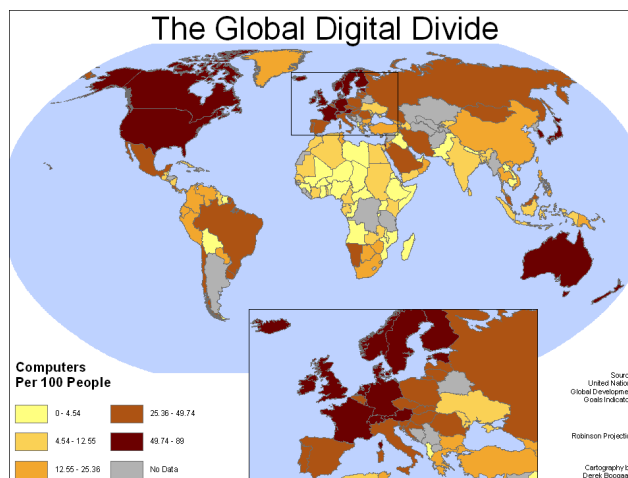yBwC4BwDCBwDIBwDIBwA&sclient=img#vhid=iBFp
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Figure 11. Global Digital Divide

Source:https://www.google.com/search?sca_esv=e8
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Figure 12. Automation

Source:https://www.google.com/search?q=images+
on+automation+in+digitalization+by+wikipedia&s
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Figure 13. Digital literacy

Source:https://www.google.com/search?sca_esv=e8
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