

The future of work in the age of the fourth industrial revolution: Implications for the South African telecommunications industry

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Abstract: The Fourth Industrial Revolution (4IR) has introduced significant changes to the global telecommunications industry including South Africa. As a result of innovations and changes in digital technology, the South African telecommunications industry is actively adopting the latest applications and processes of digital technology for rendering efficient voice, data and text messaging services to clients. These changes present opportunities for growth in marketshare to telecommunications operators. The paper presents a summary of the main impact of 4IR on the South African telecommunications industry along with challenges and opportunities 4IR presents to the industry. Advanced applications emanating from 4IR are characterised by the integration of new technologies such as artificial intelligence (AI), the Internet of Things (IoT), big data, and cloud computing. These technologies enable the telecommunications industry to offer innovative services and products, improve operational efficiency, and enhance customer experience. However, the implementation of 4IR technologies presents challenges such as cybersecurity risks, the need for upskilling the workforce, and regulatory challenges. Despite these challenges, 4IR technologies offer opportunities for the telecommunications industry to drive economic growth, increase productivity, and create new jobs. This abstract concludes that South African telecommunications companies need to embrace 4IR technologies to remain competitive in a rapidly evolving market.

Keywords: Fourth industrial revolution (4IR), Telecommunications industry, Adoption

Introduction and background to survey

The Fourth Industrial Revolution (4IR) has brought about radical and incremental changes to the global telecommunications industry including South Africa. As a result of innovations and changes in digital technology, the South African telecommunications industry is actively adopting the latest applications and processes of digital technology for rendering efficient voice, data and text messaging services to clients (Adeosun, Shittu & Owolabi, 2022: 164-179). These changes present opportunities for growth in marketshare to telecommunications operators. This research paper provides a summary of the main impact of 4IR on the South African telecommunications industry along with challenges and opportunities 4IR presents to the industry. Advanced digital technologies enable the telecommunications industry to offer innovative services and products, improve operational efficiency, and enhance customer experience. However, the implementation of 4IR technologies presents challenges such as cybersecurity risks, the need for upskilling the workforce, and regulatory challenges. Despite these challenges, 4IR technologies offer opportunities for the telecommunications industry to drive economic growth, increase productivity, and create new jobs. This abstract concludes that South African telecommunications companies need to embrace 4IR technologies to remain competitive in a rapidly evolving market.

The Fourth Industrial Revolution (4IR) is a term used to describe the current era of rapid technological advancement, where cutting-edge technologies such as artificial intelligence, robotics, and the internet of things (IoT) are being developed and deployed at an unprecedented pace (Nyagadza, Pashapa, Chare, Mazuruse & Hove, 2022). Telecommunication companies have been at the forefront of this revolution, driving innovation and development of these new technologies in their quest to stay ahead of the competition. The paper provides a summary of key factors that undermine the efficiency of digital technology in the telecommunication industry, and recommends strategies for improving digital technology utilisation. This includes training and development

programmes for employees, upgrades to digital infrastructure and systems, and the adoption of new technologies to streamline business processes.

South Africa's telecommunications industry has undergone significant changes with the advent of the Fourth Industrial Revolution (4IR). The term 4IR refers to the current era of technological advancements characterised by the fusion of digital, physical, and biological systems. This fusion has led to the development of new technologies such as artificial intelligence (AI), internet of things (IoT), 5G networks, cloud computing, big data analytics, and cybersecurity. In South Africa, the telecommunications industry is a critical sector that has enabled the country to leapfrog into the digital age (Bag & Wood, 2022). The industry has played a pivotal role in connecting people, facilitating commerce, and improving access to information. With the adoption of 4IR technologies, the industry has become even more essential in driving economic growth and improving the lives of citizens.

The introduction of 5G networks has been a significant development in the South African telecommunications industry. This technology promises faster data transfer, lower latency, and massive connectivity, enabling the implementation of IoT and AI applications (Peerally, Santiago, De Fuentes & Moghavvemi, 2022). The South African Government has recognised the importance of 5G and has initiated several projects aimed at rolling out 5G infrastructure across the country. Cloud computing has also emerged as a vital technology in the South African telecommunications industry. Cloud computing enables the delivery of computing services over the internet, allowing remote access to data and applications. This technology has facilitated network virtualisation, network function virtualization, and network slicing, which have led to increased efficiency and reduced costs.

However, with the increasing adoption of 4IR technologies comes the need for increased cybersecurity measures. South Africa has been a target for cyber-attacks in recent years, and the telecommunications industry has not been spared. The industry is, therefore, required to implement robust cybersecurity measures to protect against these threats. The Fourth Industrial Revolution has transformed the South African telecommunications industry, providing new opportunities for growth and development. The adoption of 4IR technologies such as 5G networks, cloud computing, and AI has enabled the industry to become even more critical in driving economic growth and improving the lives of citizens. The South African telecommunications industry is one of the most advanced on the African continent, with a competitive market that has enabled significant investments in infrastructure and services. The industry has contributed significantly to the country's economy, providing employment opportunities and facilitating economic growth. However, the industry faces various challenges, such as regulatory issues, high infrastructure costs, and limited access to services in rural areas. The adoption of 4IR technologies has the potential to address some of these challenges while providing new opportunities for growth and development. For instance, the introduction of 5G networks promises faster data transfer, lower latency, and massive connectivity, enabling the implementation of IoT and AI applications. Cloud computing has facilitated network virtualization, network function virtualisation, and network slicing, leading to increased efficiency and reduced costs. However, the adoption of these technologies also poses new challenges, particularly in the area of cybersecurity. South Africa has been a target for cyber-attacks in recent years, and the telecommunications industry has not been spared. The industry is, therefore, required to implement robust cybersecurity measures to protect against these threats (Phoobane, Masinde & Mabhaudhi, 2022). Overall, the adoption of 4IR technologies has significant implications for the South African telecommunications industry, and understanding these implications is crucial for policymakers, regulators, and industry stakeholders. This study aims to contribute to this understanding by exploring the impact of 4IR technologies on the industry and identifying the challenges and opportunities that arise from their adoption.

Rationale of study

The Fourth Industrial Revolution (4IR) has overwhelmed the South African telecommunications industry (Malomane, Musonda & Okoro, 2022). Developments that have resulted from 4IR have made it essential for the South African telecommunications industry to master and internalise the latest digital technological processes and applications in order to remain relevant to the industry. The sector needs to understand the impact of emerging technologies on the industry and to identify opportunities and challenges that arise from these changes. The study aims to examine how 4IR technologies such as 5G networks, artificial intelligence, and the Internet of Things (IoT) are changing the way telecommunications companies operate, and how they can use these technologies to improve their services and stay competitive. By studying the impact of 4IR in South Africa's telecommunications sector, researchers and industry stakeholders can identify new business models, products, and services that can be developed to address the changing needs of consumers and businesses (Maphalala, Mncube & Mkhasibe, 2022).

Additionally, the study can provide insights into how 4IR technologies can be used to address socio-economic challenges in South Africa, such as improving access to education and healthcare services, promoting digital inclusion, and supporting economic development. Overall, the objective of studying 4IR in South Africa's telecommunications sector is to inform policy and decision-making by providing a comprehensive understanding of the opportunities and challenges presented by emerging technologies, and to support the development of innovative solutions that can help to drive growth and social progress (Benassi, Grinza, Rentocchini & Rondi, 2022).

Theoretical framework of study

Sarker (2022) has shown that the telecommunications industry is a sector that has been significantly transformed by advancements made in the Fourth Industrial Revolution (4IR). Advanced processes and applications in artificial intelligence (AI), robotics, the Internet of Things (IoT), Web3, blockchain, 3D printing, genetic engineering, quantum computing and similar digital applications have enabled telecommunications service providers to offer highly efficient services at an affordable cost. Digital technology has enabled telecommunications service providers to reach out to huge and diverse population groups and users. This trend is likely to continue in the next several years.

Internet of Things (IoT): IoT is a network of interconnected physical devices, vehicles, and other objects that can communicate with each other and exchange data. In telecommunications, IoT has enabled the development of smart cities, connected homes, and industrial automation. Gopichandran, Ganeshkumar, Dash and Ramasamy (2020) have pointed out that the reliance on artificial intelligence operations will continue to rise significantly in the next few years. The number of IoT connections is expected to reach 24.1 billion by 2030, with the majority of connections being in the manufacturing, logistics, and utilities sectors.

Artificial Intelligence (AI): AI refers to the ability of machines to perform tasks that typically require human intelligence, such as decision-making, natural language processing, and image recognition. In telecommunications, AI is used for network optimization, customer service, and predictive maintenance. A report by GSMA (2019) states that the global spending on AI in the telecommunications industry is expected to reach \$15.7 billion by 2025 (Bhalerao, Kumar, Kumar & Pujari, 2022).

5G Networks: 5G is the fifth generation of wireless networks, which offers faster data transfer, low latency, and high reliability. 5G is expected to facilitate the implementation of IoT and AI applications in telecommunications. According to a report by MarketsandMarkets (2021), the 5G infrastructure market size is expected to grow from \$2.2 billion in 2020 to \$42.7 billion by 2025 (Liang, He, Li, Guo & Zhang, 2022).

Cloud computing refers to the delivery of computing services over the internet. In telecommunications, cloud computing is used for network virtualization, network function virtualization, and network slicing. The global telecom cloud market size is expected to grow from \$22.2 billion in 2019 to \$73.8 billion by 2026 (Krakowski, Luger & Raisch, 2022).

Big Data Analytics: Big data refers to large and complex datasets generated from various sources such as social media, sensors, and IoT devices. In telecommunications, big data analytics is used to gain insights into customer behaviour, network performance, and business operations. According to a report by Allied Market Research (2021), the global big data analytics in the telecom market size is expected to grow from \$3.3 billion in 2018 to \$10.7 billion by 2025 (Fathi, Haghi Kashani, Jameii & Mahdipour, 2022: 1247-1275).

Cybersecurity: As the use of IoT, AI, and cloud computing increases, so does the risk of cyber-attacks. Cybersecurity is, therefore, a crucial aspect of 4IR in telecommunications. According to a report by Markets and Markets (2021), the global cybersecurity market size is expected to grow from \$152.7 billion in 2018 to \$248.3 billion by 2023 (Zhang, Ning, Shi, Farha, Xu, Xu & Choo, 2022).

Literature review

The Fourth Industrial Revolution (4IR) has significant implications for the telecommunications industry in South Africa. In this literature review, we will discuss some of the key findings and insights from academic research and industry reports on the impact of 4IR on the South African telecommunications industry.

Infrastructure related requirements: The adoption of 4IR technology requires a significant investment in infrastructure to support the growing demand for data, and this presents a significant challenge for the South African telecommunications industry. Katz, Jung and Callorda (2020:1-9) have pointed out that South African telecommunications operators need to expand and maintain their infrastructure significantly in order to be able to use 4IR and AI based technologies effectively. This includes a significant investment in areas such as fiber optic networks, data centers, and network capacity.

Connectivity and access: Utilising 4IR based technologies provides an opportunity for the South African telecommunications industry to improve connectivity and provide better access to digital services, particularly in underserved areas. Howell and Potgieter (2022:1-17) have pointed out that the South African telecommunications industry needs to upgrade its current infrastructure and improve connectivity and access related obstacles. The authors have argued that the South African Independent Communications Authority of South Africa (ICASA) needs to play a much more proactive role in this regard. There are still significant challenges in terms of connectivity and access, particularly in rural areas, and that the industry needs to do more to address these challenges.

Regulatory environment: The regulatory environment in South Africa plays a significant role in shaping the telecommunications industry, and it is important that regulations are updated to reflect the changing landscape of the 4IR. Molatelo Ramahlo, Pillay and Madzimore (2022: 15-25) have shown that the regulatory environment should be relaxed so that more work can be done easily and effectively. The authors have argued that the regulatory framework must be user-friendly so that it is possible to promote innovation and investment in emerging technologies such as 5G and the Internet of Things.

Skills and talent: The 4IR requires a skilled workforce with expertise in emerging technologies, and this presents a challenge for the South African telecommunications industry. Aruleba and Jere (2022) have shown that there is a shortage of skilled workers in the telecommunications industry of developing nations such as South Africa, and that the industry needs to do more to attract and retain talent.

Collaboration and partnerships: The effective adoption of 4IR based technologies requires collaboration and partnerships between industry players, policymakers, and other stakeholders. The study by Chen, Chau and Li (2019: 973-992) shows that it is highly beneficial to collaborate and partner with the private sector. The authors have shown that collaboration is a driver of innovation and growth in the global telecommunications industry.

Examples of ways in which telecommunication companies are embracing 4IR include the following:

5G Technology: Telecommunication companies are investing heavily in 5G technology, which is expected to revolutionize the way we connect and interact with the world around us. 5G promises lightning-fast speeds, low latency, and high bandwidth, which will enable new applications such as remote surgery, autonomous vehicles, and smart cities.

Internet of Things (IoT): This refers to the network of devices, vehicles, and home appliances that are connected to the internet, allowing them to communicate with each other and exchange data. Telecommunication companies are playing a critical role in developing and deploying IoT technology, which has the potential to transform industries such as healthcare, agriculture, and transportation.

Artificial Intelligence (AI): Telecommunication companies are using AI to improve customer service and network performance. For example, AI-powered chatbots can handle customer inquiries 24/7, while machine learning algorithms can analyse network data to identify potential problems before they occur.

Cloud Computing: Telecommunication companies are leveraging cloud computing technology to improve their operations and service offerings. Cloud computing allows companies to store and process large amounts of data, which can be accessed from anywhere in the world, enabling new services such as remote data analysis and virtual reality.

In conclusion, telecommunication companies are actively embracing the 4IR, using cutting-edge technologies to improve their services, develop new applications, and stay ahead of the competition.

Technological processes that are essential for telecommunications companies

The Fourth Industrial Revolution (4IR) is transforming the telecommunication industry in various ways. In this response, we will discuss the methods and materials of study for 4IR in telecommunication companies.

Data Analytics is one of the critical tools used in the telecommunications industry to enhance customer experiences, detect fraud, and reduce churn rate. Telecommunication companies use various techniques such as machine learning, artificial intelligence, and big data to process and analyse vast amounts of data. Companies like Verizon, AT&T, and T-Mobile have developed robust data analytics capabilities to enhance their business operations.

Georgiadou, Mouzakitis, Bounas and Askounis (2022: 452-462) have shown that the Internet of Things (IoT) is transforming the telecommunication industry by connecting devices, enabling real-time communication, and creating new business models. Telecommunication companies have invested heavily in IoT infrastructure, including network infrastructure, IoT platforms, and applications. For instance, Verizon has launched Thing Space, an IoT platform, to help developers create IoT applications.

Ferrag, Friha, Hamouda, Maglaras and Janicke (2022: 40281-40306) have shown that 5G networks are the latest generation of cellular networks that are expected to transform the telecommunication industry by providing faster data speeds, lower latency, and improved reliability. Telecommunication companies are investing heavily in 5G infrastructure, including radio access networks, core networks, and cloud infrastructure. For instance, AT&T has launched a 5G network in the United States, and Verizon has deployed 5G networks in several cities.

Artificial Intelligence (AI) is being used in the telecommunications industry extensively. In the next several years, the use of AI will continue to rise significantly. The industry needs AI to enhance customer experiences, detect fraud, and automate business processes. Telecommunication companies use AI techniques such as machine learning and natural language processing to process vast amounts of data and provide personalized services to customers. For instance, Vodafone has implemented an AI-based chatbot to provide customer support.

The telecommunication industry is undergoing a significant transformation through the adoption of 4IR technologies. Data analytics, IoT, 5G networks, and AI are some of the critical tools that telecommunication companies are using to enhance their business operations and provide superior customer experiences.

Implications of 4IR to the South African telecommunications industry

The Fourth Industrial Revolution (4IR) has transformed the telecommunications sector in South Africa significantly (Phoobane, Masinde & Mabhaudhi, 2022). The authors have shown that reliance on 4IR and AI will continue to rise significantly in the next several years. The telecommunication sector is going to evolve significantly due to the impact of advanced technologies in digital technology and AI. The integration of 4IR technologies has brought about significant improvements in communication networks, increased internet connectivity, and the creation of new job opportunities. One of the most notable benefits of 4IR in the SA telecommunications sector is the enhancement of communication networks. The use of 4IR technologies such as 5G networks, the Internet of Things (IoT), and Artificial Intelligence (AI) has led to the creation of faster and more efficient communication systems. This has improved the quality of communication services, resulting in an increased customer base and revenue for telecommunications companies.

In addition to improving communication networks, 4IR technologies have also increased internet connectivity across South Africa. With the deployment of 5G networks, more people can access the internet at faster speeds, which has led to the creation of new business opportunities and the growth of e-commerce. This has also enabled telecommunication companies to provide innovative services such as telemedicine, distance learning, and remote working.

Zhang, Ning, Shi, Farha, Xu, Xu and Choo (2022) have pointed out that the adoption of 4IR technologies has also created new job opportunities in the telecommunications sector. With the deployment of new communication networks and the introduction of new services, there is a need for skilled professionals in areas such as network engineering, cybersecurity, data analysis, and AI. This has contributed to the growth of the job market in South Africa, particularly in the technology sector. However, despite the benefits of 4IR in the telecommunications sector,

there are also challenges that need to be addressed. One of the challenges is the issue of access to 4IR technologies, particularly in rural areas. Many people in remote areas still lack access to high-speed internet and advanced communication networks, which limits their ability to benefit from the advantages of 4IR technologies.

The adoption of 4IR technologies in the telecommunications sector in South Africa has brought about significant improvements in communication networks, increased internet connectivity, and the creation of new job opportunities. However, there is a need for more efforts to address the challenges of access to these technologies in remote areas, to ensure that the benefits of 4IR are enjoyed by all South Africans. The Fourth Industrial Revolution (4IR) is having a significant impact on South Africa across various sectors. In this literature review, we will discuss some of the key findings and insights from academic research and industry reports on the impact of 4IR in South Africa (Alexander, 2022).

The successful adoption of 4IR, AI and IoT by the telecommunication industry has the following socioeconomic implications:

Economic impact: The 4IR has the potential to significantly boost economic growth in South Africa, particularly in areas such as manufacturing, services, and agriculture. The World Economic Forum (2022) has pointed out that 4IR technologies could add up to \$425 billion to South Africa's GDP by 2026, and create up to 4.5 million new jobs.

Social impact: The 4IR is also having a significant impact on South African society, particularly in terms of education, healthcare, and access to digital services. Gaglio, Kraemer-Mbula and Lorenz (2022) shows that 4IR presents an opportunity for South Africa to address social challenges such as poverty and inequality, by improving access to education and healthcare through digital technologies.

Environmental impact: The 4IR has the potential to contribute to South Africa's sustainability goals, particularly in terms of reducing carbon emissions and addressing climate change. A survey carried out by Kastouni and Lahcen (2022: 2758-2770) shows that 4IR technologies such as renewable energy, smart grids, and intelligent transportation systems could significantly reduce South Africa's carbon footprint.

Workforce impact: The 4IR is also having a significant impact on the South African workforce, particularly in terms of job displacement and the need for new skills. A study by Yu (2022: 92-111) shows that the adoption of 4IR technologies could lead to job losses in some industries, but also create new job opportunities in emerging fields such as robotics and artificial intelligence.

Policy related impact: The 4IR is also having an impact on policy and regulation in South Africa, particularly in areas such as education, innovation, and intellectual property. Smidt and Jokonya (2022: 558-584) have shown that the South African Government needs to develop policies and strategies that promote the adoption of 4IR technologies and support innovation and entrepreneurship.

Challenges and opportunities

Challenges and opportunities facing telecommunication companies in SA as they navigate the 4IR. The Fourth Industrial Revolution (4IR) presents both challenges and opportunities for the telecommunications industry in South Africa. In this response, we will discuss some of the challenges and opportunities facing telecommunication companies in SA as they navigate the 4IR.

Advanced applications of 4IR require significant investment in infrastructure, including upgrading and expanding network capacity, building data centers, and deploying fiber optic networks. Telecommunication companies in SA face challenges in accessing funding for such large-scale infrastructure investments. Applications of 4IR require a skilled workforce with expertise in emerging technologies such as artificial intelligence, data analytics, and the Internet of Things. Telecommunication companies in SA face challenges in attracting and retaining talent due to competition from other industries and a shortage of skilled workers.

The telecommunications industry in SA is heavily regulated, which can create challenges for companies trying to navigate the 4IR. For example, companies may face regulatory hurdles when deploying new technologies such as

5G networks. According to the World Economic Forum (2022), Digital Transformation (DT) and 4IR present an opportunity for telecommunication companies in SA to embrace digital transformation, improve their business processes, and create new revenue streams. By leveraging emerging technologies such as data analytics, artificial intelligence, and the Internet of Things, companies can gain insights into customer behaviour, improve operational efficiency, and create innovative products and services.

Advancement in 4IR provides an opportunity for telecommunication companies in SA to enhance connectivity and provide better access to digital services, particularly in rural areas. By investing in infrastructure and expanding network coverage, companies can bring digital services to underserved communities and contribute to economic development.

Advancement in 4IR requires collaboration between industry players, policymakers, and other stakeholders. Telecommunication companies in SA have an opportunity to collaborate with other industry players to build a more robust technology ecosystem, share expertise, and drive innovation. While 4IR presents challenges for telecommunication companies in South Africa, it also provides significant opportunities for growth and innovation. By investing in infrastructure, talent, and digital transformation, companies can create new revenue streams, enhance connectivity, and drive economic growth. Collaboration among industry players and policymakers is critical to unlocking the full potential of the 4IR for the telecommunications industry in South Africa.

The telecommunications industry has been significantly impacted by the Fourth Industrial Revolution (4IR), which is characterized by the integration of physical, digital and biological systems. In this literature review, we will explore the impact of 4IR on the telecoms industry.

One of the key impacts of 4IR on telecoms is the shift towards network virtualization and software-defined networking (SDN). Network virtualization is the creation of virtual networks using software that abstracts the underlying hardware. This allows for greater flexibility and scalability of networks. SDN is a network architecture that separates the control and data planes of the network, allowing for more efficient network management.

Another impact of 4IR on the telecoms industry is the emergence of 5G technology. 5G is the fifth generation of wireless technology and provides faster data transfer rates, lower latency and increased capacity. 5G technology is expected to enable a range of new applications, such as autonomous vehicles and smart cities. The Internet of Things (IoT) is another area of impact for the telecoms industry in the 4IR era. IoT refers to the connection of physical devices to the internet. This creates a network of devices that can communicate with each other and with other systems. Telecoms companies are well positioned to provide the connectivity needed for IoT devices. Artificial intelligence (AI) is another area of impact for the telecoms industry in the 4IR era. AI can be used to optimise network performance, automate network management, and improve the quality and efficiency of connectivity in telecommunications services.

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