Wholesale&Retail LEADERSHIP CHAIR

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W&RSETA
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"Collaboration opens the window to a world of opportunities."

Research Paper

Project: 2022/P3/001

Post COVID-19 Technology Adoption in the South African Wholesale and Retail Sector: Strategies and Practices

Final Report : 7 November 2024

APPLIED RESEARCH
LEADERSHIP DEVELOPMENT
SERVICE TO RETAIL COMMUNITY

Project: 2022/P3/001

Post COVID-19 Technology Adoption in the South African Wholesale and Retail Sector: Strategies and Practices

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"Collaboration opens the window to a world of opportunities"

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6. ABSTRACT

Businesses worldwide are striving to reap the benefits of the newest and emerging 4IR and 5IR technologies for competitive advantage. The wholesale and retail outlets are two supply chain players in which tracking and tracing each product's movement is critical as businesses seek real-time monitoring and control solutions to improve their core processes to enhance customer experience.

***For its methodology**, the research used open-ended questions to analyze the extent of the market adoption and possible utilization of technology-mediated systems. The initial responses were reviewed and critiqued by industry experts in group discussions, with participants spanning small, medium, and large enterprises to provide a range of perspectives on lived experiences. This was done after reading the initial report for sense-making.*

***The findings** of the study indicate that new technologies are enabling tasks traditionally performed by humans to shift towards automated systems, although adoption is limited by constraints, particularly the costs of implementing new systems. Where 4IR and 5IR technologies have been adopted, users reported improvements in operational efficiency, security, and reliability. Tools such as AI and ML are highlighted as pivotal in automating the wholesale and retail sector, with adoption varying depending on factors like enterprise size, business type, and customer profile.*

Keywords: artificial intelligence, technologies, W&R sector, implemented 4IR and 5IR technologies, strategies, practices

7. ABBREVIATIONS & ACRONYMS

4IR - Fourth Industrial Revolution

5IR - Fifth Industrial Revolution

AGV - Automated Guided Vehicle

AI - Artificial Intelligence

AR - Augmented Reality

B2B - Business-to-Business

B2C - Business-to-Consumer

BDM - Big Data Mining

BRICS - Brazil, Russia, India, China, South Africa

CATI - Computer Aided Telephone Interview

CCTV - Closed Circuit Television

ECOWAS - Economic Community of West African States

FGD - Focus Group Discussion

GDP - Gross Domestic Product

GPS - Global Positioning System

HR - Human Resources

ICT - Information and Communications Technology KPIs - Key Performance Indicators

IoT - Internet of Things

IT – Information and Technology

KPI - Key Performance Indicator

ML - Machine Learning

mPOS - mobile Point-of-Sale

PLU - Price Look Up

POS - Point of Sale

RFID - Radio Frequency Identification

ROI - Return on Investment

SADC - Southern African Development Community

SETA - Sector Education and Training Authority

SMEs - Small and Medium-sized Enterprises VR - Virtual Reality

StatsSA – Statistics South Africa

TIPS - Technology, Innovation, People & Systems

TVET - Technical Vocational Education and Training

UK - United Kingdom

USA - United States of America

VR - Virtual Reality

WMS - Warehouse Management System

W&R - Wholesale and Retail

W&RSETA - Wholesale and Retail Sector Education and Training Authority

8. INTRODUCTION

1.1 Background

If South Africa, as a member of the BRICS Plus group, is to remain a committed participant in this economic hub, it must stay aligned with its more developed partners by adopting a macro-economic approach to assess how it can keep pace with technologies emerging from the Fourth (4IR) and Fifth Industrial Revolutions (5IR). The transition from pre-COVID-19 ways of working to new, technology-driven strategies will necessitate significant shifts in how the Wholesale and Retail (W&R) sector operates, especially as the sector's training authority.

To navigate this transition, the sector must be guided by an institutional understanding of the forces driving this change and the prevailing economic parameters in key industries that shape future opportunities for adopting 4IR and 5IR technologies. Developing new technological skills is essential for the sector to remain agile, competitive, and sustainable, enabling it to compete globally in the digital economy. These advancements will underpin hybrid approaches to work, despite the challenges and potential threats they may pose to both the sector and its workforce.

The Wholesale and Retail Sector Education and Training Authority (W&RSETA), one of the top five Sector Education and Training Authorities (SETAs) in South Africa, contributes 12.5% to the country's gross domestic product (GDP) (W&RSETA Annual Report 2021/2022). To remain effective, it must continuously conduct intelligence exercises in collaboration with relevant stakeholders. These efforts are designed to generate data that supports the development of credible institutional mechanisms for transitioning to new technologies across the industries it serves. This is particularly important in light of the disruptions caused by the recent COVID-19 pandemic. The sector was severely affected when trading was curtailed due to the stringent lockdown measures introduced by the government to curb the spread of the virus. The sector faced a double blow with the onset of the July 2021 unrest, which resulted in significant losses and setbacks as businesses were again forced to close for indefinite periods. More recently, flooding and hurricane incidents in some parts of South Africa have compelled industries to focus on recovery strategies at the expense of technological advancements.

1.2 Pre-COVID-19 technology status in the W&R sector

Pre-COVID-19 markets were relatively steady, and demand planners within organizations could, with the exception of fuel, almost accurately forecast the volumes of goods required and calculate costs, as demand and the exchange of goods were fairly predictable. Planning from a supply chain perspective was relatively straightforward. However, the W&R industry in South Africa had begun to undergo significant transformation in the years leading up to COVID-19, with technology playing a crucial role in shaping its trajectory. The pre-COVID-19 era had started to witness a gradual integration of technology into the sector, resulting in enhanced operational efficiency and improved customer experience. Research by Vosloo (2019) highlights that the implementation of technologies such as point-of-sale (POS) systems, inventory management software, and e-commerce platforms had already begun to improve operational efficiency and customer experience long before the pandemic. Additionally, the integration of radio frequency identification (RFID) technology in supply chain management has started to facilitate accurate inventory tracking and reduce stock losses (Bitzer, Bezuidenhout & Geldenhuys, 2020).

1.3 Technological advancements during COVID-19

During the pandemic, the new operational needs that emerged accelerated the pace of technology adoption in the wholesale and retail industry in South Africa. With lockdown measures and social distancing protocols becoming the norm, businesses swiftly turned to digital solutions to sustain operations. Technology-driven innovations like virtual reality (VR) and augmented reality (AR) were explored to enhance the new reality of the online shopping experience (Goga, Mayer & Tshetsha, 2021). During this period, e-commerce platforms experienced a surge in demand as consumers shifted towards online shopping (Goga et al., 2021). A report by the South African Council of Shopping Centres (2020) indicated that 76% of retailers had intensified their investment in e-commerce during the pandemic. Furthermore, the adoption of contactless payment systems, such as mobile wallets and card tap-and-go technologies, became essential for minimizing physical contact and promoting hygiene practices (Mungai et al., 2021).

The negative experiences of many businesses during COVID-19 forced those that had not seriously explored 4IR technologies to reassess their positions. The unpredictable business environment necessitated careful planning and the development of contingency plans to address potential supply chain bottlenecks. Businesses that had been running warehouses on spreadsheets were compelled to transition to technology for managing their stock. The new business realities required the W&R sector to be more agile and versatile, particularly as the costs of maintaining warehouses continued to escalate. The limited inflow of goods

negatively impacted small and medium-sized enterprises (SMEs) with long-term contracts with warehouses, as these contracts had to be honored despite the lack of products on shelves to sell.

The pandemic exposed a significant gap in research into alternative markets and storage options. Many warehouses and retail outlets were forced to develop new contingency plans that prioritized continuity and sustainability, highlighting the growing relevance of big data mining (BDM). This has raised questions about how the sector can better equip itself to withstand another disruption of the same scale as the COVID-19 pandemic. As a result, strategies needed to be reconfigured to adapt to the new way of operating. At that time, and still today, South Africa lags behind the developed world in adopting technology-mediated warehousing and retailing strategies. However, it remains a leader in Africa and is a member of several economic hubs, such as the Southern African Development Community (SADC) and the Economic Community of West African States (ECOWAS), with which it holds intra-regional agreements. To maintain this leadership, it is crucial for South Africa to stay at the forefront of technological developments.

1.4. Post-COVID-19 technological status

The post-COVID-19 period has markedly influenced the adoption of 4IR and 5IR technologies across various sectors. This shift stems from deliberate changes in work systems and processes aimed at enhancing services. Innovations such as remote working tools, e-commerce platforms, and AI-driven analytics have emerged as prominent trends. These advancements have not only enabled organizations to adapt to the new normal of e-commerce but have also transformed industries and influenced societal behaviors.

Despite the progress made before and during the COVID-19 pandemic, technology adoption in South Africa's W&R sector has been slow and continues to face significant challenges. A study by Mpinganjira et al. (2019) identified several barriers, including limited access to affordable technology, inadequate digital infrastructure, and resistance to change. Furthermore, concerns around data privacy and cybersecurity, as noted by Bitzer et al. (2020), remain key obstacles for businesses considering digital transformation (Bitzer et al., 2020).

Furthermore, a study by Njenga et al. (2021) highlighted that many SMEs in the W&R sector lack the necessary resources and expertise to implement and maintain digital systems. Moreover, challenges related to the current energy crisis and connectivity issues, particularly in remote areas, have hindered the seamless integration of technology into business processes (Goga et al., 2021). These challenges continue to obstruct the widespread adoption of technology in the W&R sector in South Africa.

It is therefore crucial for policymakers, industry stakeholders, and technology providers to address these challenges and provide support to enable rapid and sustainable technology adoption in the W&R sector. By doing so, South Africa can harness the full potential of technology to drive innovation, competitiveness, and sustainability in the sector.

In the post-COVID-19 era, digitalization and the rise of the "Internet of Things" (IoT) are expanding rapidly. Organizations that hesitate to adapt their operational strategies and practices to this evolving landscape risk losing market share and experiencing overall organizational decline (Chan, Teoh, Yeow, & Pan, 2018; Sestino, Prete, Piper, & Guido, 2020). Sustainability in the retail sector during the 4IR and 5IR era relies on the swift adoption of emerging technologies to enhance the delivery of high-quality, digitally customized products and services (Noble, Mende, Grewal & Parasuraman, 2022). The failure of retail organizations to innovate in tandem with the automation of operations, digital technologies, and machine interactions of the 4IR and 5IR could lead to unsustainable business practices and a lack of clarity in strategic goals and objectives, thereby hindering competitive strength (de Vass, Shee & Miah, 2021; Loginov; Noble et al., 2022). As the last node within the supply chain that manages the sales of various industry products, the retail sector has the responsibility to embrace the implementation of technologies if it is to remain viable.

One of the aims of the W&RSETA is to continue commissioning sectoral research through collaborations with academics and independent research institutes. This research aims to evaluate the significance and impact of the 4IR and 5IR as major drivers of change within the sector. In addition, the long-term effects of the COVID-19 pandemic, along with other potential disruptions to technological advancement, must be considered in future planning related to 4IR and 5IR. This is especially relevant as the focus increasingly shifts toward conversion technologies.

1.5 Problem statement

A brief survey of the W&R landscape in South Africa reveals that the sector has not yet fully embraced 4IR and 5IR technologies. These technologies have the potential to enhance customer service and satisfaction by integrating new innovations into enterprise models, which would, in turn, improve operational efficiency and ensure the sector remains competitive and viable.

9. LITERATURE REVIEW

2.1. Emerging technologies

Digitalization and the era of IoT, also referred to as AI, is defined as the science and engineering of creating intelligent machines, particularly computer programs, designed to perform tasks and skills traditionally associated with human intelligence. This advancement enables work typically carried out by humans to be replaced by technological systems. Closely linked to AI is Machine Learning (ML), a discipline that employs software applications to perform complex tasks and has the potential to execute both routine and non-routine functions in e-commerce and brick-and-mortar enterprises, resulting in widely applicable automated systems that reduce operational time and human workload. ML-based analyses have proven useful in conducting product and customer reviews where data is available (Hussein, Mirza, Hussain, Iqbal & Memon, 2020). Enterprises within the W&R sector are effectively adopting and assimilating these new technologies.

In economies based on specialization and the division of labor, trade companies are compelled to create value through activities that involve purchasing goods from various manufacturers and suppliers, transporting, stocking, and sorting them for distribution to wholesalers and retailers, while utilizing emerging technologies for greater efficiency. Varadarajan, Welden, Arunachalam, Haenlein and Gupta (2022) argue that this is because the sales of a product define its value and enhance the revenue inflow of the entire supply chain, which has become consumer-centered. Digital connectivity that promotes smart product and service delivery has become the strategic tool driving product sales and service quality in the W&R sector. The evolving types of retail have been differentiated between brick-and-mortar retailing conducted from a fixed location and online selling or distance trading. The two approaches, according to Dinu (2021:5), call for "…the development of market strategies of the Proximity Marketing type, which communicate to real and potential customers the specific offer depending on their buying behavior". Dinu (2021) further advises implementers of AI and researchers about the benefits and risks of introducing AI into trade and commerce, which may include ethical, legal, and societal aspects previously unknown. There is a need, therefore, for coherent and collaborative digital systems from the manufacturer to the end user, aimed at improving productivity, service quality, and profits. It is also important to differentiate between the 4IR and 5IR. While the 4IR has been characterized as a driver of innovation through the use of new operational technology – almost seeking progress for its own sake – the 5IR is better aligned with the needs of humanity and is likely to enhance customer management in terms of business and customer satisfaction.

2.2. Function of the wholesale sector

In recent years, there has been growing interest in supply and demand response as a strategy to enhance reliability in wholesaling. As a vital link in the supply value chain, wholesaling connects producers to end users, playing a key role in product distribution. To ensure efficient delivery to retail customers, the wholesale industry must operate as a supply chain system capable of accurately tracking product consumption patterns, maintaining stock records, and managing distribution processes at both national and international levels. With rising market demands and the adoption of new technologies across business sectors, innovative approaches to modeling and scheduling interconnected supply chains are essential. These strategies help to maximize profit while minimizing demand uncertainty, which can lead to issues such as understocking or overstocking by wholesalers (Sardar, Sarker & Kim, 2021). As the distributor of goods from manufacturers to retailers, wholesalers require a sophisticated information system architecture initially proposed by Shuttle (2017), which advocates for machine-oriented, administrative, and decision-making tasks ranging from ordering goods and managing inventory to responding to customer requirements, handling goods, billing, and distributing products. Operational tasks also encompass other downstream processes such as customer service, returns, and complaints management. The integration of AI and ML in these processes would yield benefits such as building valuable databases, improving response times, and providing streamlined client service.

2.3. Function of the retail sector

Retail has seen more changes with the emergence of new technologies compared to wholesaling. Many retailers have extended their in-store operations by adding online channels or adopting entirely new e-commerce models, allowing them to sell products online without the need for a physical store. E-commerce saw substantial growth during and after the pandemic. Research by Dwivedi et al. (2020) indicates a surge in online shopping, leading to increased investment in e-commerce platforms, digital payment systems, and last-mile delivery solutions. In e-commerce, there are varying degrees to which a transaction must be digital, which can vary along a continuum, starting with predictive market analysis, informing the decision-making process, applying a systems approach to the sales process, and capturing sales and other data flows, which may include an inventory of returned goods. Examples of this may include cases of wrong deliveries or damaged goods. As in wholesaling, business intelligence can also be used for ordering goods, managing goods, serving customers, and distributing goods. The pandemic significantly altered consumer behavior, leading to a pronounced shift towards contactless and online transactions.

During the disruptive change resulting from the COVID-19 pandemic, many digital platforms and capabilities

were invested in to sustain businesses. In the United Kingdom (UK), one of the countries hardest hit by the pandemic and resultant lockdowns, artificial intelligence in the form of AI capabilities came into greater use to streamline operations for home-bound customers. The use of end-to-end retail management software, such as accounting, payments, and invoice generation, is now being applied in wholesale to balance inventory and identify overstocked and understocked items, aiding in pricing strategies for competitive pricing and market analysis. AI has also optimized product visibility through camera installations in large warehouses. In the United States of America (USA), major conglomerates like Amazon and Walmart have adopted in-store technologies such as automated POS and payment options, which have been introduced to enhance the shopping experience for customers (Hutsch & Wulfert, 2022). In Europe, particularly in Germany, supply chain disruptions caused by the pandemic, as well as the recent war in Ukraine and record inflation driven by soaring energy prices, have compelled W&R sectors to find new ways to transform into fully digitalized operations and achieve maturity levels across various sizes of enterprises, from small to medium and large.

The McKinsey Report (2022) on sustainability and digitalization of the W&R sector states that digital interactions have become the norm, with projections indicating that the profit share from e-commerce will increase from 15% to 30% by 2030. The same report projects that, with the right investment, the W&R sector "could evolve into a truly Omni-channel industry that provides a seamless experience for the customer, boasts automation across the value chain and scales up advanced analytics to drive growth and operational efficiency and modernize IT". Germany, like other European countries, has introduced automated self-checkout counters. AI in the form of emerging computer vision technologies, including cameras and sensors, is being used extensively, and multiple digital applications performing functions such as smart shelving to track inventory (Hutsch & Wulfert, 2022) have become part of in-store operations.

Inventory management is closely linked to demand forecasting, which is crucial during times of extreme shortages caused by unforeseen circumstances, as seen during the onset of COVID-19. During such times, workers should be able to replace products flying off the shelves, and wholesalers, through the use of collaborative technologies, should be able to replenish stock seamlessly. Amazon in the USA has leveraged machine learning to assist in gathering market intelligence, resulting in sustainable production and consumption. The USA has reportedly advanced ahead of Europe, with most retail outlets making significant use of AI, ML, Web 3 technology, automation, and robotic process automation (Hunt, 2022). Furthermore, the ability of retail outlets to accept various digital payment methods, such as code payments, virtual payments, and cryptocurrency payments, has enabled greater accessibility for online and offline shoppers.

Dalin-Kaptzan (2020) has also noted the global proliferation of product/service flow reconfiguration, such as in business-to-consumer (B2C) and business-to-business (B2B) e-commerce. Information flow reconfiguration, such as in cloud computing and global positioning systems (GPS), as well as cash flow reconfiguration, such as in self-checkout points and mobile point-of-sale (mPOS) systems, are being used extensively.

Closely linked to AI is the hardware of robotics, which has various applications, such as operational food delivery. For example, drones have been used for last-mile parcel delivery. AI in wholesale or in-store environments has also expanded to include verbal smart assistants like Siri, enabling customers to use handheld devices to find products in-store or order from home (Shotwell, 2023). While these in-store applications have revolutionized shopping and enhanced the customer experience, some technologies are still challenging to implement. Their success depends on factors such as store architecture, location, and customer demographics and preferences.

Shotwell (2023) further highlights the current trends in online and in-store applications that are becoming commonplace. The software has been developed to track customer traffic, item tracking, and in-store suggestions, which can influence customer purchasing behavior. This same software can also track trends or facilitate immersive shopping experiences, allowing customers to virtually try on clothing items before making a purchase. Augmented reality can assist retail workers in visualizing the shop floor and shelves before setting them up. Self-checkout applications and inventory management systems are already in use in Australia, and consumer behavior analysis using big data is employed to match customer spending with their demographics. This provides retailers with a better understanding of how to market their brands to meet the needs of the majority of their customers (McAfee & Brynjolfsson, 2017).

2.4. Factors hindering the successful implementation of 4IR and 5IR technologies in the W&R sector in South Africa

While significant progress has been made in adopting 4IR and 5IR technologies, not all W&R outlets have fully embraced these innovations. Some retail companies abroad have yet to take advantage of or invest in AI applications. As Van Heck (2020) warns, realizing the full value of emerging technologies can be extremely challenging for many establishments due to a variety of factors. Gartner (2019), a consultancy firm, explains the "hype cycle" that emerging technologies typically undergo. This cycle consists of five phases: (1) the *technology trigger* phase, which usually begins in a lab setting; (2) the *peak of inflated expectations*, where companies explore its potential use; (3) the *disillusionment* phase, when it becomes apparent that the

technology may not be as effective as initially believed; (4) the *slope of enlightenment*, where the integration of business and technology is explored; and (5) the *plateau of productivity*, when businesses learn how to fully utilize the technology to create value. This final phase can take 5 to 10 years to be realized, becoming the "next normal" (Dinu, 2021).

2.5. The current state of affairs in the W&R sector

While the W&R industry in South Africa had already begun undergoing significant technological changes, the outbreak of the COVID-19 pandemic rapidly accelerated the pace of technology adoption across several sectors. With lockdown measures and social distancing protocols in effect, businesses quickly turned to digital solutions to sustain operations. E-commerce platforms saw a surge in demand as consumers shifted toward online shopping. A report by the South African Council of Shopping Centres (2020) revealed that 76% of retailers increased their investment in e-commerce during the pandemic. Despite the initial surge in the adoption of technology-mediated systems, a study by Redflank (2020), in collaboration with the W&RSETA, revealed that over 40% of retail businesses in South Africa have not yet fully embraced 4IR technologies. The report further indicates that 30% of businesses are aware of the necessary technologies but are still exploring their potential benefits. Meanwhile, 19% are at the experimental stage, testing these technologies to assess whether they will deliver the anticipated results. Only 8% have successfully aligned their systems with new AI and ML technologies, and just 3% have fully adopted these innovations and are in the process of scaling up their operations to deploy these emerging technologies.

While there has been progress in adopting 4IR and 5IR technologies, several factors contribute to the slow pace of change. Amidst high inflation and a weakening rand, many companies in South Africa face resource constraints that hinder technological advancements. The IDC White Paper (2020) highlights several barriers to the uptake of technology-mediated solutions, including a general lack of understanding of the benefits of emerging technologies, prohibitive start-up costs, and a shortage of critical computing skills such as data analytics, digital marketing, ICT skills, and process automation. These challenges can lead to increased wage bills for employers and more complex workforce management. Additionally, the automation of entry-level jobs could result in job losses in a highly unionized environment, where unemployment rates are estimated to be between 44% and 62% (StatsSA 2023).

Additionally, a lack of interest or awareness from senior management can further slow the adoption of technology, as they may not fully recognize its importance in an increasingly digitized world. In some cases, existing technology platforms are outdated, and if the company's Board lacks understanding or commitment

to digital transformation, this further hampers progress. Infrastructure costs in South Africa have also proven to be a significant barrier. The country has above-average data costs, with recent research by Cable (2023) ranking South Africa 147th out of 237 countries in a global league table for mobile data costs, with high prices per 1GB of data. Poor mobile infrastructure and unsustainable data caps systematically exclude a large portion of the population from fully participating in digital environments. This becomes a major limiting factor in the drive toward the full adoption of technology across many sectors.

The challenge remains how to unlock the full value of AI and ML technologies and seize the significant opportunities for increasing profitability while improving operational efficiency. The sector must assess the current state of technology adoption, investment pressures, business and competitive sustainability, as well as challenges in the implementation of 4IR and 5IR within the W&R sector in South Africa, where there is currently limited empirical research.

10. METHODOLOGY

3.1. Research design

The theoretical framework adopted for this paper is the Theory of Change, which seeks to explain how new innovations contribute to a chain of results, ultimately leading to the evaluation of the intended outcomes or impacts of modernization. In this case, the focus is on the introduction of new technologies in the W&R sector. The Theory of Change provides a lens for selecting a specific methodology for analysis. This research examines the impact of new technologies in the W&R sector from a practitioner's perspective rather than a purely academic viewpoint.

This study is unique in that it explores and compares the adoption of 4IR and 5IR technologies implemented in developed countries, with the aim of assessing how these can be customized and adapted for local use. It further examines the current state of technology adoption in both the pre- and post-COVID-19 eras and evaluates business and competitive sustainability. Additionally, it addresses the challenges of implementing 4IR and 5IR technologies within South Africa's W&R sector, where research remains limited.

Given the nature and focus of the study, an embedded research design approach was adopted to facilitate the collection, analysis, and integration of both quantitative (though to a lesser extent) and qualitative research methods within a single study, providing a comprehensive understanding of the research problem. Certain cases or participants were selected based on their relevance and potential contribution. Participants were required to be individuals operating within the R&W sector and registered as levy-paying members, as either business owners or in managerial roles in areas such as risk management, operations management, or marketing and sales. Desktop research was also conducted to supplement data from the broader population, supporting the main objective of assessing the adoption level of 4IR and 5IR strategies.

To triangulate the findings of the research, the researcher used Focus Group Discussions (FGDs) organized with professionals involved in implementing technology-driven solutions in the W&R sector in South Africa and beyond. These FGDs were followed by a workshop/group discussion involving retailers and 4IR and 5IR "experts" to review and critique the initial draft report before finalizing it. Where possible, FGDs were held face-to-face; otherwise, they were held on Teams and recorded using Computer Aided Telephone Interviews (CATI), with participants' permission. The FGD method allowed the researcher to tap into the respondents' lived experiences, enhancing understanding of the internal and external factors relevant to the inquiry. The questions used to explore these experiences served as a qualitative method of inquiry. They consisted of a

predetermined set of semi-structured questions followed by open-ended questions, which allowed the participants to elaborate on their answers beyond the initial questions. The open-ended interview questions further enabled the participants to discuss and raise issues beyond what the researcher might have asked or considered. These interviews also sought to determine the necessity for the continuous upgrading of technologies and skills in the workplace. FGDs are particularly helpful in gathering information from a diverse population of experts, as they encourage a more critical examination of the realities on the ground, thereby corroborating evidence collected through other methods.

3.2. Limitations of the study

The researcher encountered several limitations during the study. Firstly, the demands of conducting real-world inquiry made it difficult to meet the requirements for representative sampling. Gathering data for this research was challenging, as not all organizations approached were willing to participate, despite reassurances of strict confidentiality. This reluctance may have been due to concerns about protecting intellectual property.

Secondly, delays from the W&RSETA in providing contact lists from their databases had a ripple effect on the project plan, causing deadlines to be extended. Many contacts on the lists did not respond, and others had since left their respective organizations, rendering the lists outdated.

Thirdly, there was a general lack of interest from the “experts” or professionals in targeted organizations, likely due to their heavy workloads. It also became apparent that the sector's low level of engagement was partly due to poor stakeholder relationships with the training authority. Additionally, the researcher had to follow up on appointments and questionnaires two or three times before receiving feedback, which further delayed the research process.

11. FINDINGS

4.1. Introduction

The findings presented below are based on responses from 29 participants contacted through the CATI tool, e-mail, and direct telephone interviews. The findings and discussions have been analyzed and organized according to the themes that emerged from the data. The responses are not attributed to individuals but are presented as summarized accounts of the individuals interviewed. Altogether, 5 small, 5 medium, and 19 large organizations responded to the questionnaire. The respondents had a strong knowledge of the topic and included individuals from IT, risk management, operations, store managers, innovation specialists, project managers, and personnel from Human Resources (HR) and skills development. Companies involved included Massmart, Dischem, Woolworths, Takealot, DHL, Pick 'n Pay, Checkers, Spar, and others, and where possible, the same warehouse and retail store brand were interviewed. Several SETA officials also provided their opinions on the topic of study.

4.1.1 Demographics of the respondents

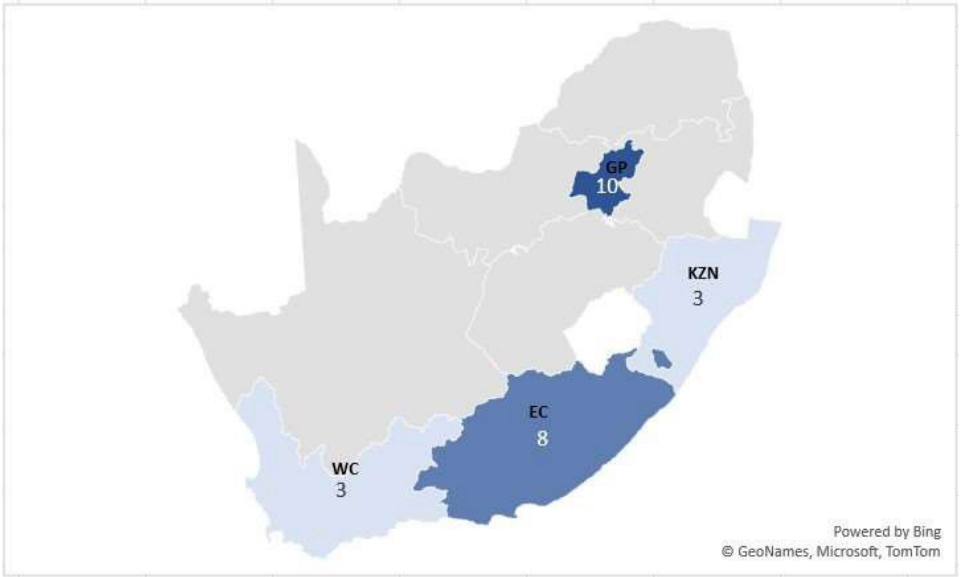

Figure 1: Distribution of responding organizations by province

The figure above illustrates the concentration of respondents, which aligns with the locations of major ports of entry and airports. These areas serve as key hubs for warehouses, where goods are received from abroad, distributed nationwide, or exported.

4.1.2. The nature of the business of the respondents

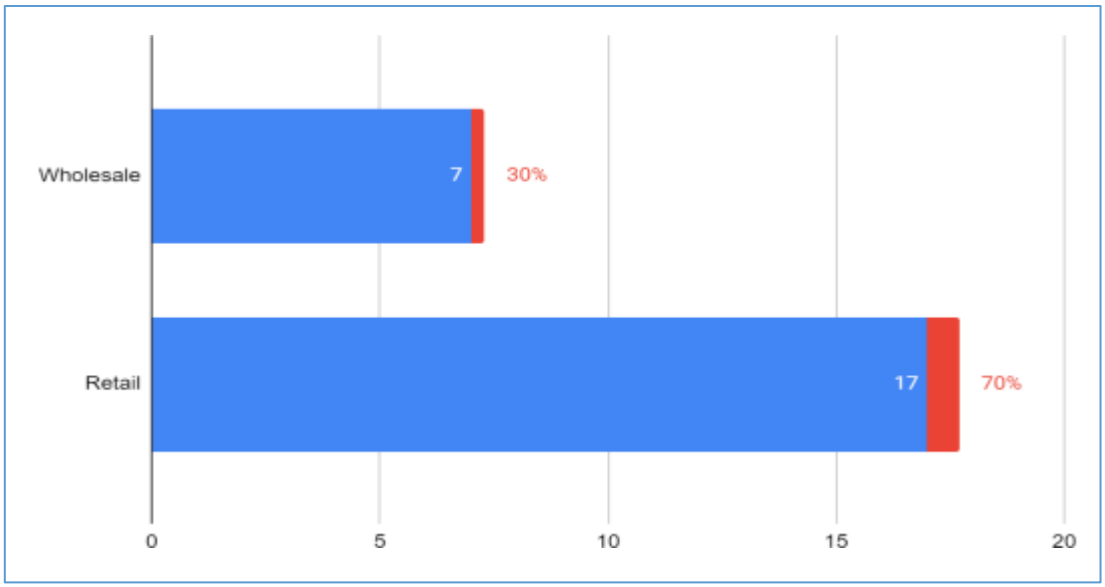

Figure 2: The nature of the business of the respondents – wholesale or retail organization

Figure 2 indicates that a greater number of respondents came from the retail sector, as access to potential participants was more easily obtained through walk-in searches for key personnel. In these cases, the purpose of the research was explained directly to relevant staff. In contrast, entry into warehouses was more challenging due to stringent security protocols.

Line of business of the respondents

Efforts were made to gather responses from participants across various lines of business to assess the adoption of 4IR and 5IR technologies before, during, and after the COVID-19 era. Smaller businesses were underrepresented in the sample, as many found high-end technology unaffordable and, in some cases, unnecessary due to the lower volumes of stock they handled. These businesses often chose a more cautious approach, opting to observe how their competitors were integrating new technologies before making any commitments. Small entrepreneurs, particularly those operating in the township economy, have adopted strategies such as bulk purchasing and securing alternative storage facilities closer to their retail outlets.

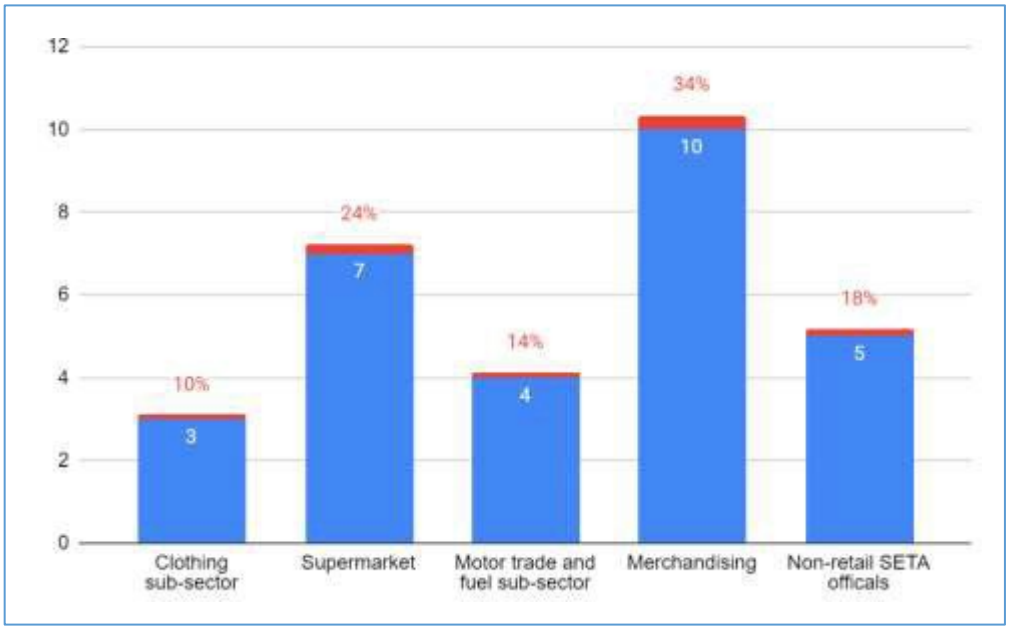

Figure 3: Respondents' line of business

4.1.3 The size of the organizations represented in the sample

As discussed above, large organizations were more receptive to participating in the research compared to small and medium-sized businesses. This might be because the larger organizations have more to gain from research as they look for ways to grow their businesses, while the smaller businesses are more preoccupied with sustainability in an ever-shrinking economy.

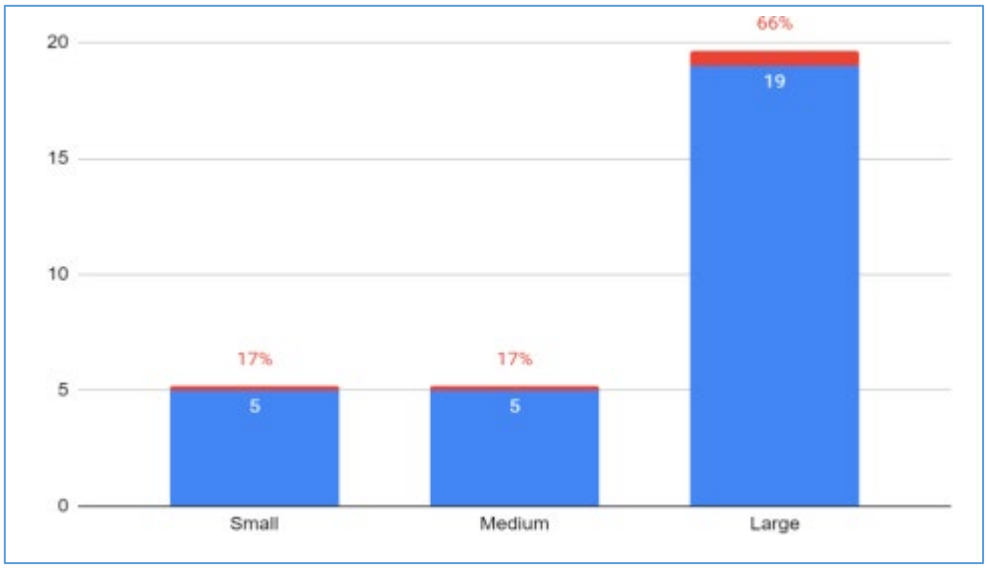

Figure 4: Size of organization

4.1.4 Indication of whether the business was already using/exploring 4IR/5IR technologies before COVID-19 in March 2020

Figure 5 below shows that, contrary to the common perception regarding the use of new technologies, businesses in the W&R Sector had already begun using software and devices to introduce efficiencies into their operations. The advent of COVID-19 accelerated this transformation.

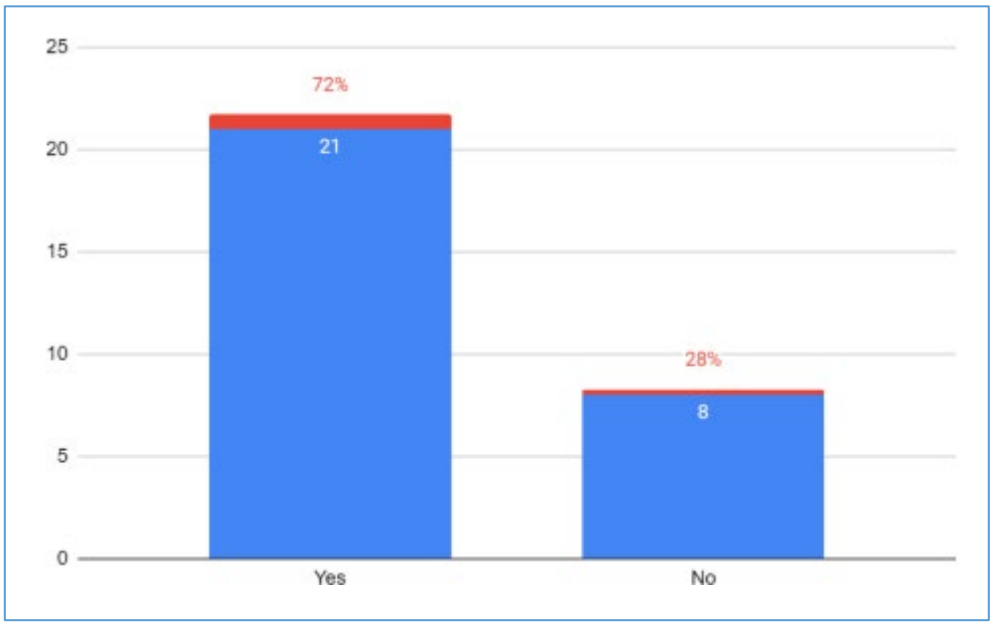

Figure 5: 4IR/5IR technology adoption before COVID-19

Out of the 29 responses received, 21 businesses were already using 4IR and 5IR technologies, though to varying degrees. Retail reported a greater usage of technology at the POS, as sales can now be linked with in-store inventory systems, resulting in greater accuracy in stock management. These technologies are primarily used by medium to large retail shops.

4.1.5. Current state of adoption of 4IR and 5IR technologies in organizations

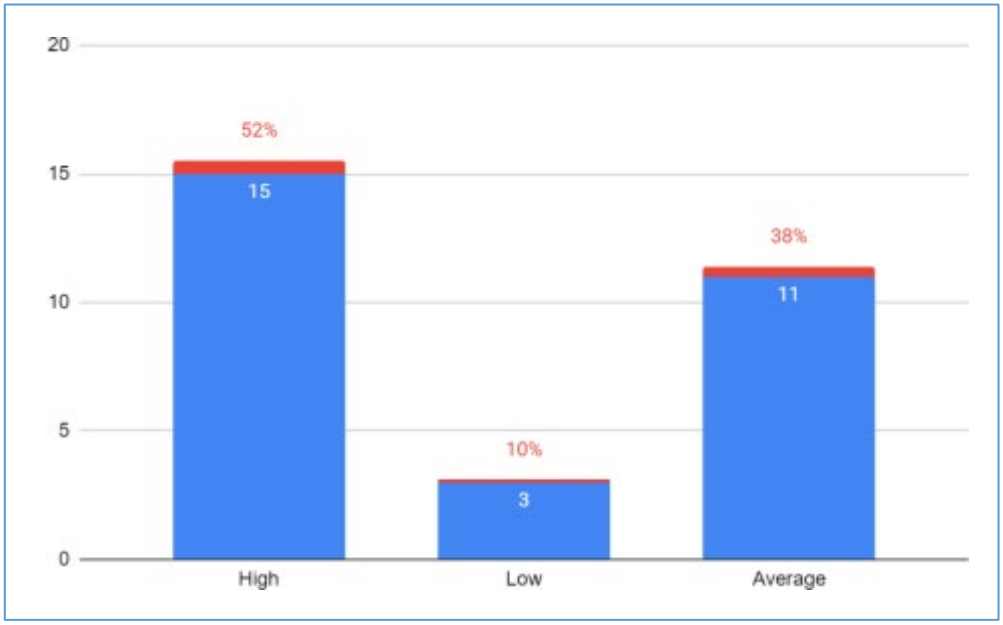

Figure 6: Respondents' current state of adoption of 4IR and 5IR technologies in organizations

Fifteen respondents indicated that the current adoption of 4IR and 5IR technologies in their organizations is high, with significant investments made in new technologies to enhance operations. Warehousing has taken the lead in adopting high-end technology, as the focus has shifted from merely receiving goods from manufacturers to distributing them to retail locations. Best practices in developed economies now emphasize the super efficiency of warehouses, which are being operated as cost containment and quality control centers. This is achieved by merging several smaller warehouses into mega warehouses, as both large and medium-sized companies recognize the advantages of technology in managing goods more efficiently and profitably. In some instances, reports indicate that smaller companies are now outsourcing their logistics to warehouses capable of handling the inflow and outflow of their goods.

The state of adoption is subject to variations. Large companies, in particular, have the financial, infrastructural, and resource capabilities for innovations and have therefore managed to adopt technology more quickly. Game stores, for example, are now using self-checkout tills in some of their outlets.

Where adoption and usage of 4IR and 5IR technologies have been low, it is because some companies, particularly mid-sized warehouses and retail organizations, are slowly transitioning from legacy technology as they build the necessary infrastructure to incorporate 4IR and 5IR technologies. In other instances, the

adoption of high-end technology has not become part of the organization's strategy or transformation agenda and is therefore not backed by policy, meaning that no resources have been allocated to technology that would impact management training and capacity building for employees.

There has also been a lack of comprehensive studies or research on the usage of 4IR and 5IR technologies, and where such studies have existed, the dissemination of new information has been piecemeal and disproportionate. Expectations of innovation in this regard have therefore been fluid and uncertain. Township economies, in particular, require support in understanding the advantages of cost-efficient collective warehousing and retailing that would take advantage of economies of scale to enable greater use of technology beyond the widely used "Yoco" card payment and Snap Scan devices used at POS by most small-scale entrepreneurs.

Additionally, the low uptake of technology in the small business sector has been exacerbated by a shortage of technical and digital skills required to manage businesses in the 21st century. On the part of SMEs, as confirmed by three respondents, there has been no deliberate and sustained effort or structures and systems to enable the emergence of a new generation of wholesalers and retailers, resulting in the low uptake of modern technologies for doing business. A lack of resources, limited access to training, ICT support, and poor connectivity have hampered efforts to successfully implement 4IR and 5IR-mediated technologies in the sector. All respondents cited the energy crisis in South Africa as having stalled efforts to digitalize business processes.

4.1.6 Focus of technologies

Respondents from both warehousing and retail sectors were asked about the primary focus of their technology initiatives. The key focus areas identified are outlined below:

Figure 7: Focus of technologies post COVID-19

Ten respondents confirmed that the main focus of 4IR and 5IR adoption has been the advancement of e-

commerce, greater use of AI and ML in warehousing, and taking the lead in automating their processes. Their main focus has been inventory systems. This was confirmed by six respondents from warehousing, where processes are more standardized with fewer variations compared to retail. Big data has also been at the center of arguments for the introduction of new technologies.

For respondents who reported low usage of technology in their organizations, the following reasons were provided:

Figure 8: Reasons for low usage of technology

4.1.7. Factors identified as enablers of the successful implementation of 4IR and 5IR-mediated technologies so far

The research identified similar enablers of the introduction of new technologies as shown in the cloud presentation below with most of them pointing out the importance of a clear and well-articulated strategy as indicated below.

Figure 9: Enablers for the successful implementation of 4IR and 5IR technologies

Twenty-one respondents from medium and large organizations highlighted several key enablers for the successful implementation of 4IR and 5IR technologies within their businesses. These included robust operating models, strong internet bandwidth, the digitalization of processes, and the overall adaptability of

their organizations. One respondent emphasized the crucial role played by their research and innovation hub in informing management and decision-makers about the benefits of migrating to newer technologies for more effective business management. Additionally, some respondents mentioned successful initiatives in adopting crypto technologies and blockchain.

Other enablers cited were a deep understanding of supply chain processes, insights into consumer expectations, and financial investment, along with targeted training. Change management programs also played a significant role, as critics of innovation were gradually persuaded. Three large organizations specifically noted that their ability to implement such programs and training was a direct result of having the necessary resources to adopt change management strategies and training.

4.1.8. Strategies used to adopt and implement key 4IR and 5IR technologies

Figure 10: Key strategies used by respondents to adopt and implement 4IR and 5IR technologies

The strategies identified as enablers of technology adoption by medium to large companies included adapting proven methods for their own use and implementing key technologies through benchmarking exercises with both local and international companies. Five large organizations indicated that the first step in this process was to convince company boards to move away from traditional business practices by clearly articulating the benefits and impact of new technologies. The second step was to demonstrate the Return on Investment (ROI) of adopting such strategies.

Following this, the focus would be on collaborating with top management to emphasize the need for change in business practices and the competitive advantage that could be gained by adopting new technologies. Another critical strategy was sourcing key talent to manage the implementation and maintenance of these technologies. Respondents from the SME category suggested that government grants should be offered to help them acquire technology systems, which would improve their operational efficiency and profitability.

4.1.9. New skills required to enable employees to conduct their work

A number of new or enhanced skills were required to enable employees to perform effectively in technology-mediated environments. These skills include the following:

Table 1: New skills required to enable employees to conduct work in technology-mediated environments

Hard Core skills	Enabling and Supporting skills
Data analysts	Strategic leadership & management skills
Robotics engineers	Retail operational management skills
Solar engineering technicians	Regulatory compliance
Programmers	Industry-specific technical skills
ICT skills and security specialists	Entrepreneurial skills
Complex problem & critical thinking skills	Research and development skills
Decision-making skills	Skilling, reskilling & upskilling

Larger organizations were able to hire high-end talent both locally and internationally, while SMEs had to outsource expertise, which proved costly. This reliance on external specialists led to delays in adopting certain technologies that required a diverse range of advanced technical skills.

4.1.10. Organizational infrastructures currently in place to enable the adoption of 4IR and 5IR technology

Figure 11: Infrastructures currently in place to enable the adoption of 4IR and 5IR technologies

All nineteen large organizations confirmed that the organizational structures necessary for the successful adoption of 4IR and 5IR technologies include faster computer processing, GPS systems, and the IoT. However, five SME respondents noted that these technologies are largely inaccessible to smaller businesses.

4.1.11. Factors contributing to pressure to invest in 4IR and 5IR technologies

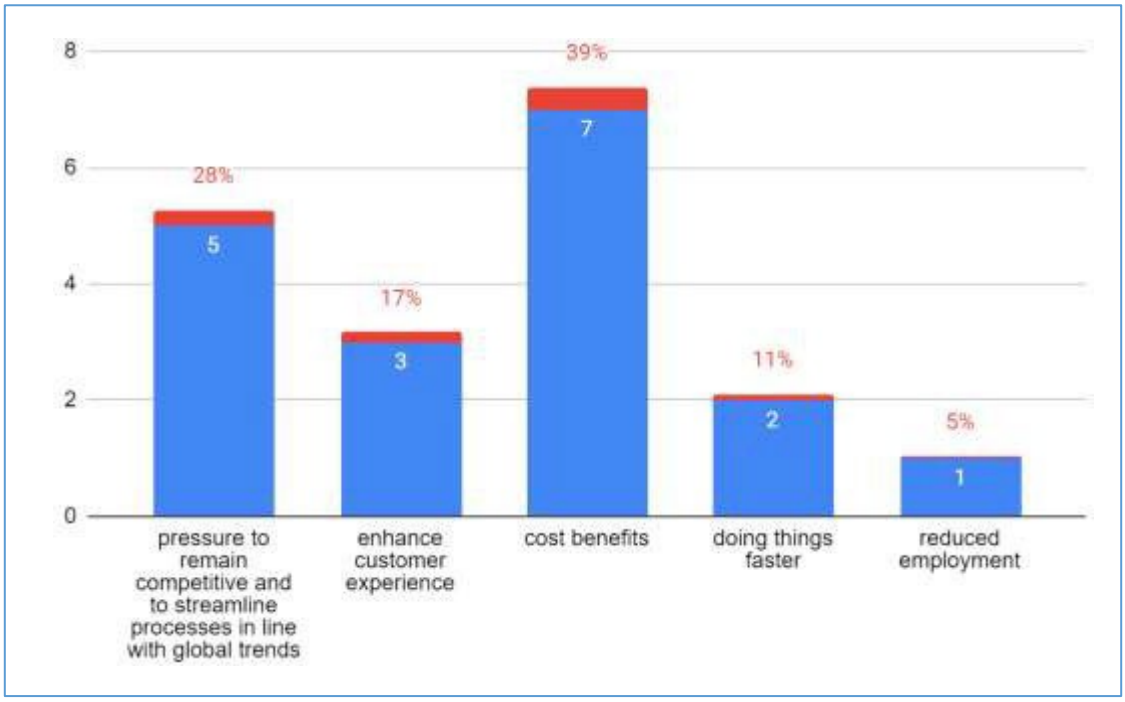

Figure 12: Factors contributing to the pressure to invest in 4IR and 5IR technologies

Of the eighteen respondents who answered the question regarding factors contributing to the pressure to invest in 4IR and 5IR technologies, five attributed the pressure to the need to remain competitive and streamline processes in line with global trends. Three respondents highlighted the importance of enhancing the customer experience through modern technologies, while seven cited cost benefits as a driving factor. Two respondents mentioned that companies were seeking ways to operate more efficiently, and only one respondent pointed to reduced employment as a reason for the pressure to adopt new technologies.

Young entrepreneurs emphasized that many of their tech-savvy customers preferred using newer technologies, which they found faster, more secure, and offering better buying options. Technology has increasingly replaced manual tasks once performed by employees, and for companies to do business with one another, their operational systems must be compatible. This has forced the emergence of new dynamics across all sectors. The need to stay proactive and keep up with leading markets has further fueled the adoption of these technologies.

4.1.12. New technologies in the pipeline

Of the six respondents who answered this question, the sentiment was that most organizations were still in the process of testing newly acquired technologies. However, they remained vigilant, ready to adopt any emerging technologies quickly to differentiate their businesses in the market and offer unique services.

Limited suggestions of technologies that could add more value to the W&R sector were provided, including:

Table 2: Emerging technologies in the wholesale and retail sector

Wholesale	Retail
Robotics	More self-service systems
Cloud technology	Biometric systems @POS
Optical character recognition systems	
Holographic product displays	

4.1.13 How the needs for 4IR and 5IR-mediated technologies have been determined in the respondents' organizations

Various organizations have adopted 4IR and 5IR technologies at different times and for diverse reasons. Businesses do not exist in a vacuum, nor can they thrive in isolation. The desire to find improved ways of conducting business for greater profit has been the primary driving force behind most warehouses and retail outlets seeking new operational methods.

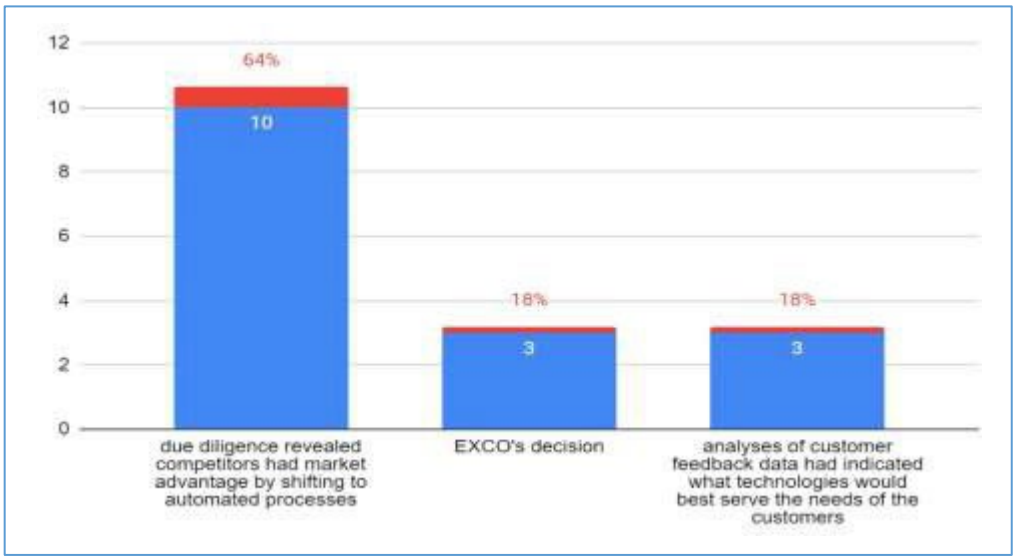

Figure 13: How the needs for 4IR and 5IR-mediated technologies have been determined in the respondents' organizations

Of the sixteen respondents who answered the question regarding how the needs for the shift towards the adoption of 4IR and 5IR technologies were determined, the majority – ten respondents – indicated that these needs were identified through due diligence, which revealed that their competitors were transitioning from manual to automated processes, placing them at the forefront of competition. Another three respondents stated that the needs originated from the EXCO level, where most decision-makers within their organizations were located, while the remaining three reported that analyses of customer feedback data indicated which technologies would best serve customer needs. By researching leading trends in the W&R sectors and the drivers of innovation, operations managers, business analysts, and others began to recognize the necessity for adopting 4IR and 5IR technologies.

4.1.14 How 4IR and 5IR technologies can address competitive challenges

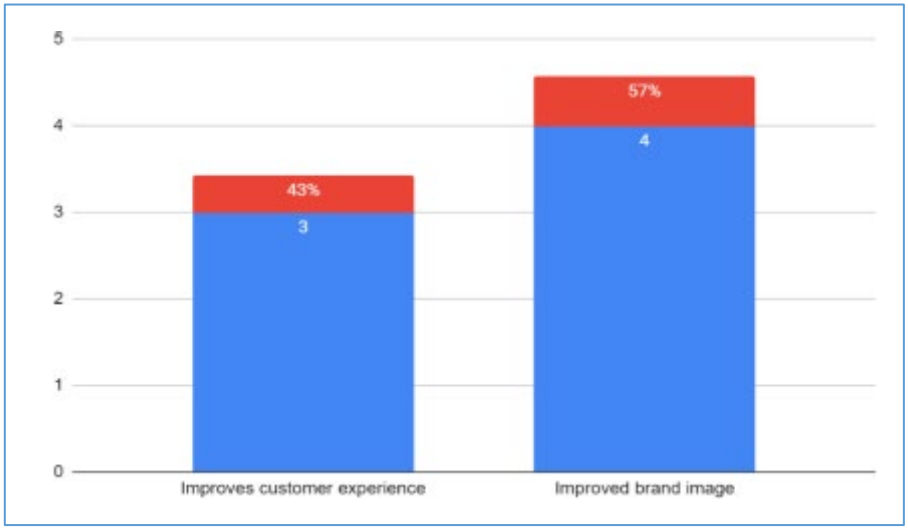

Figure 14: How 4IR and 5IR technologies can address competitive challenges

Full or partial adoption of 4IR and 5IR technologies has given companies first out of the block competitive advantage by enabling faster delivery of business outcomes and greater efficiency through the automation of various processes. Three respondents from the retail industry, out of seven who answered the question, stated that automation improved the customer experience, which in turn increased their market share. Another four respondents from the retail sector noted that the use of modern technologies enhanced their brand image, resulting in increased foot traffic and greater visibility for online business. Big data, when analyzed and insights are mined in a timely manner, can lead to customer preference listings based on shopping history, serving as an effective tool for direct marketing. While ICT uptake is widespread, it is not always focused on advanced technologies. However, during the pandemic, the use of technology by some successful entrepreneurs contributed to a significant level of resilience, as they were able to diversify their marketing channels, ensuring continued business growth. The technology needs of SMEs expanded to include computer literacy, the acquisition of basic computing devices such as laptops and smartphones, and access to networks and devices like barcode scanners. Additionally, there was a growing demand for software skills, including coding, website development, and graphic design. Small businesses increasingly embraced online marketing, and their online presence through social media, websites, and other office software grew exponentially.

4.1.15. Challenges hindering the successful implementation of 4IR and 5IR technologies in South Africa

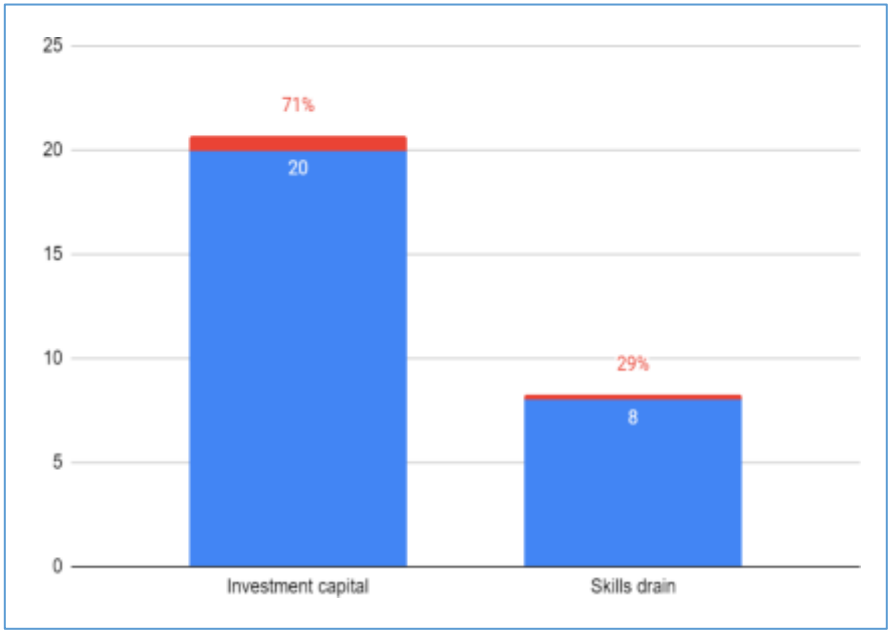

Figure 15: Challenges hindering the successful implementation of 4IR and 5IR technologies in South Africa

Several challenges are currently hindering the successful implementation of 4IR and 5IR technologies. A respondent from one of South Africa's leading retail stores noted that, despite the shift toward more technology-driven operations, many customers still prefer personal, one-on-one interactions with store staff who provide excellent service. Some customers also prefer to physically inspect and feel merchandise before making a purchase, while for others, in-store shopping remains an occasional outing, particularly for senior shoppers.

A greater challenge, as stated by the twenty respondents, is the investment capital required to set up a technology-based retail or wholesale outlet. Another eight respondents cited the skills drain in South Africa, which contributes to the “revolving door syndrome” – where staff trained in new technologies leave the organization for greener pastures. The biggest challenge, however, remains the high cost of capital investment needed to set up new digital systems.

4.1.16. Barriers and limitations to the successful implementation of 4IR and 5IR technologies

The barriers and limitations to the successful implementation of 4IR and 5IR technologies were identified across all three levels of enterprises – small, medium, and large – in both warehousing and retail sectors. The key challenges noted are summarized below, along with proposed measures to mitigate them.

Table 3: Barriers to the successful implementation of 4IR and 5IR and mitigation measures

Barriers to the successful implementation of 4IR & 5IR	How barriers can be mitigated
Energy shortage	Due to frequent downtime from energy disruptions, medium-sized organizations are hesitant to fully adopt 4IR technologies, preferring a hybrid model instead. The relevant authorities must restore and maintain the grid.
No access to capital	The lack of initial capital to introduce advanced technology often forces businesses to borrow at high interest rates. Capital for infrastructure costs must be made affordable.
Talent and skills shortage	Enterprises and training authorities should focus on developing scarce and critical skills, building a surplus where necessary. Retention strategies must be prioritized, alongside rewarding local critical skills, to create a strong pipeline of talent for the future.
Lack of support from intended users	Alternative processes and procedures must be disabled (as seen with banks) to force migration to new systems.
Lack of buy-in from stakeholder and employee engagement	When new systems are introduced, key users should be involved in the decision-making process to provide input. Avoiding a silo mentality during rollout is crucial, and providing training on customer usage will enhance the uptake.

Barriers to the successful implementation of 4IR & 5IR	How barriers can be mitigated
Lack of international exposure	Key individuals involved in innovation should be given opportunities for international benchmarking, particularly with countries in the East, and encouraged to forge strategic partnerships.
Different technology requirements	Technology needs vary across enterprises. Advanced organizations use technology to build resilience and enhance efficiencies, while SMEs require access to basic technology and training.
Low education levels of customer	SMEs and consumers would benefit from targeted training initiatives aimed at facilitating migration to new technologies.
Fear of change and unintended consequences	Dedicated support and clear, targeted communication should be provided to users, as fear of change can hinder adoption and proper use of new systems.
Outright rejection of new systems	Training and addressing resistance, including uprooting rogue elements opposed to accurate monitoring and evaluation systems, is necessary to ensure smooth implementation.
Lack of buy-in from organized labor unions	Meaningful engagement with labor unions is essential to ensure that workers are not negatively impacted by technological changes. Workers should be treated as key stakeholders, and alternative job opportunities should be provided where necessary.

4.1.17. Estimations of cost for an organization to go fully digital

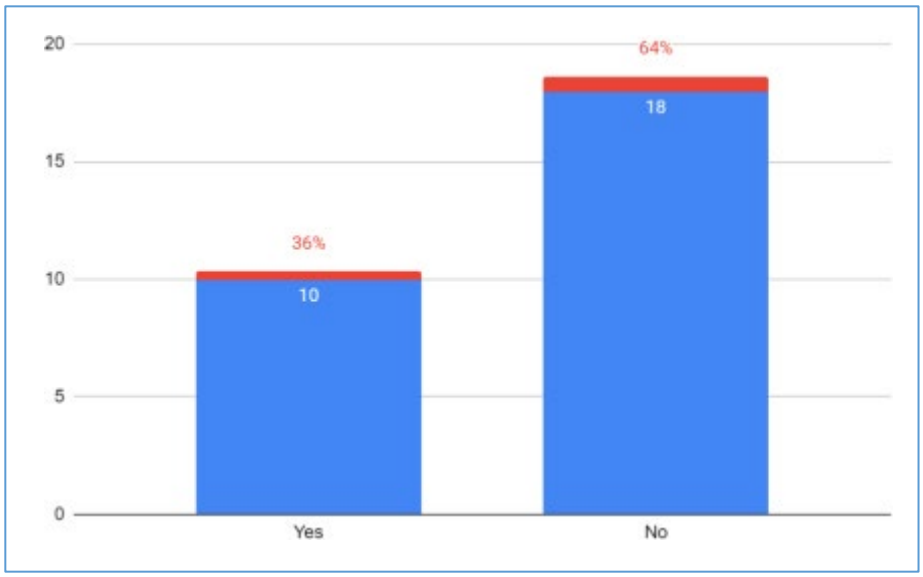

Figure 16: Knowledge of costs for the organization to go fully digital

Not many of the respondents could provide reasonable or near-accurate estimates of how much it would cost organizations to go fully digital, or how much had been invested prior to COVID-19. A respondent from a large warehouse employing over 10,000 people in various locations estimated that for the warehousing giant to go fully digital, it would cost the organization over R700,000,000. Organizations that have successfully implemented technological advancements are primarily those that are international and whose global partners or parent companies have invested heavily in local businesses, resulting in their profitability and sustainability, while also enhancing their position in the sector. Few small organizations have been able to absorb such substantial structural implementation and operational costs.

4.1.18. Changes introduced in work environments on account of the introduction of 4IR and 5IR and their impact

The introduction of new 4IR and 5IR technologies in work environments has impacted the way people work and changed their lives as a result.

Impact on work

Before COVID-19, the hybrid working model as we know it today did not exist. Most jobs were structured around the conventional 8 to 5 workday. Today, employees, depending on the nature of their jobs, can opt

to split their work schedules between working from home and working on-site. Six out of ten managers reported higher work outputs, as employees enjoy convenient and flexible working hours, which have allowed them to reallocate their time for other activities. Working from home has also led to a reduction in travel expenses, as noted by four respondents, leaving otherwise cash-strapped individuals with a bit more disposable income. Additionally, as explained by three respondents, work has become easier, with abundant opportunities to learn new or different skills. Multi-skilling has become part of work practice in both the warehousing and retail sectors. One manager pointed out that, due to the hybrid working model, several organizations have reported a reduction in office facility costs, as employees no longer fully occupy the offices. New technologies have also made decision-making easier, faster, and more accurate based on data-driven insights.

Social impact

As customers themselves, employees now experience greater convenience shopping online as they use their electronic devices to browse the internet for different buying options in the comfort of their homes. The hybrid work model has led to less road traffic as more employees choose to work from home, resulting in improved mental health in some instances due to a better work-life balance.

4.1.19. Participants' views of ROI of the introduction of 4IR and 5IR

Below are the combined insights of the participants/respondents regarding how the applied technologies have enhanced work results and improved their business strategies.

Table 4: Participants' views of ROI of the introduction of 4IR and 5IR

Business Area	
Financial Impact	- New technologies have reduced operating costs, improving gross profit margins. - Automation has reduced the salary bill by minimizing the need for manual labor. - Accurate financial reporting due to precise monitoring of income and expenditure.

Human Development Impact	- HR processes are now automated, enabling employees to perform tasks like applying for leave, downloading necessary documents, and processing requests independently. - Increased governance and policy awareness, as controls, rules, and procedures are embedded into technology, systems, and processes. - Opportunities for job enhancements, such as international sabbaticals, have facilitated skill transfer and exposure to global best practices. - More staff are being skilled, reskilled, upskilled, and sent on development courses.
Innovation input	- Organizations can keep up with major industry trends, establish innovation hubs, and foster research initiatives. - Fit-for-purpose, user-friendly, and measurable innovative technologies are being implemented. - Agile and flexible solutions are being developed to address business problems, aligning with the organization's strategic objectives. - Documentable solutions are being created for future problem-solving and engineering. - New innovations adhere to international best practices.
Technology alignment	The introduction of new working models has strengthened technology capabilities, aligning them with business strategies - Researched and sourced fit-for-purpose profiles that improve business efficacy and provide measurable outputs. - Enabled the implementation of agile business practices with technologies that adhere to international best standards.

Systems alignment	- Introduced systemic interlinks across all facets of the business - User-friendly systems accommodate a range of skill levels, from less skilled to highly skilled users. - Invested in adaptable systems that support changing business environments, enhancing business efficacy through integrated system alignment.
Alignment with company strategy	- Refocused company strategies toward digitization targets and the adoption of best practices. - All business units, particularly operations, marketing, security, and HR, have benefited from advanced technologies.
Stakeholder/client engagement	- Online stakeholder engagement has expanded customer reach and enabled accurate measurement of advertising impact. - Improved processes and stakeholder feedback have enhanced services, resulting in increased market share.
Impact on team performance	- Increased productivity has contributed to higher gross profits and revenue. - Staff awareness and tracking of team performance serve as motivators for enhanced output. - Reduction in time spent on tasks.
Personal	- Streamlined workflows due to improved operational processes. - Enhanced connectivity among employees. - New channels for self-development.

Business Area	Stated ROI of 4IR and 5IR technologies
	- Improved ways of working - Increased access to information and data sources.

The question regarding the realized ROI was not answered by a significant number of respondents, particularly in relation to innovation output, technology alignment, systems alignment, and stakeholder and client perspectives.

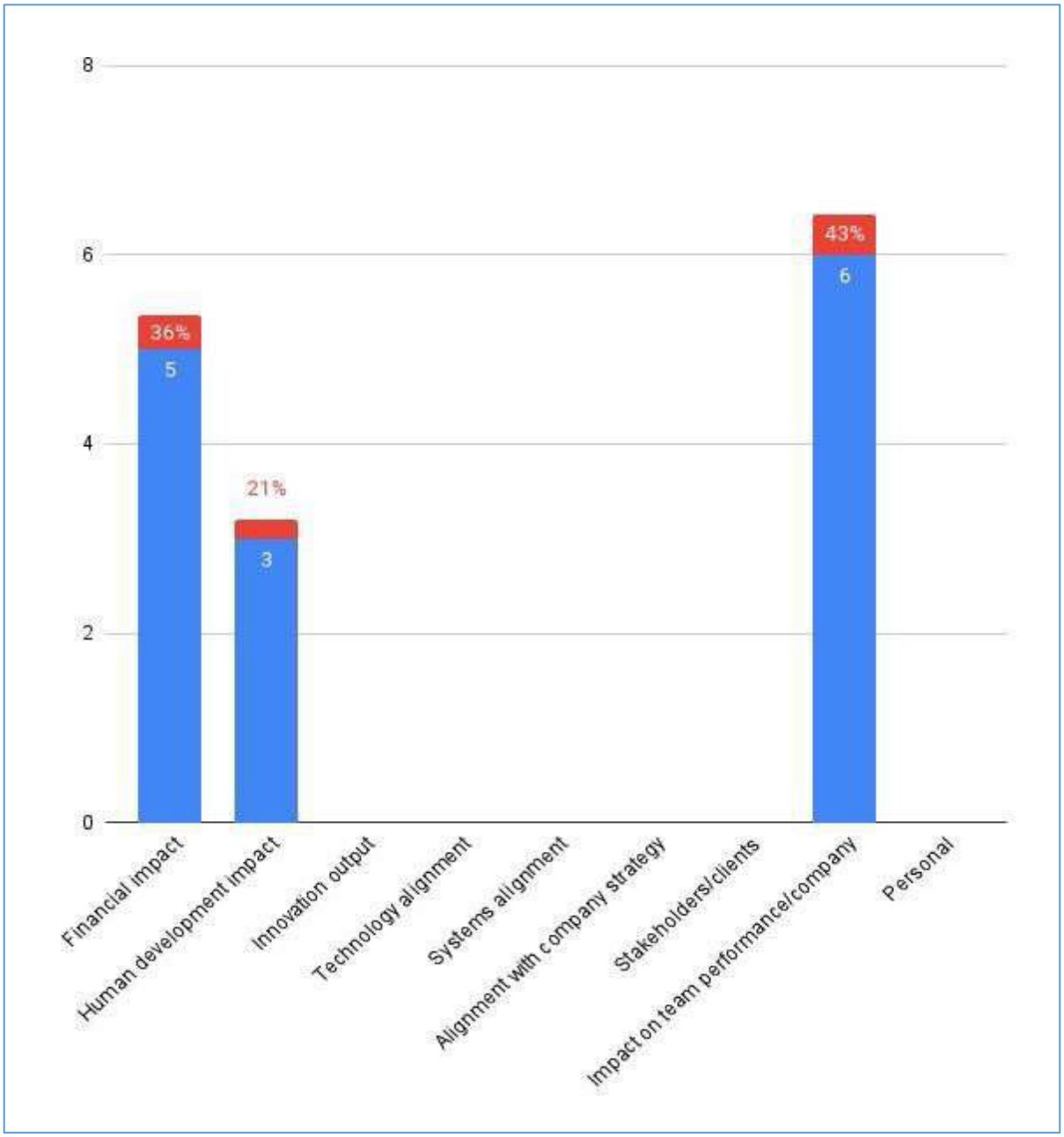

Figure 17: What has been the ROI for the introduction of 4IR and 5IR technologies?

4.2 Summary of findings

The South African W&R sector has made significant strides in adopting and implementing 4IR and 5IR technologies. Adoption had already begun before the COVID-19 pandemic as a means to enhance business performance. However, the effects of COVID-19 – including the sudden shortage of goods and lockdown protocols limiting movement – accelerated the sector's need to adapt its operations to meet customer

demand. This urgency led to the development or importation of new technologies that offered businesses a comprehensive view of available stock.

With these technologies, demand planning and forecasting became more accurate, as companies could use historical data to predict future demand, monitor purchasing trends, and manage inventory for both physical and online outlets. This shift introduced new efficiencies through the use of advanced technologies. Additionally, the big data gathered in warehouses and retail outlets enabled advanced analytics, providing invaluable insights into when, where, why, and how customers made purchasing decisions. This allowed businesses to create personalized marketing, adjust pricing according to market fluctuations, and ultimately maximize revenue while optimizing profit margins.

The introduction of these technologies, based primarily on AI and machine learning, transformed work processes, created a demand for new skills, and required new approaches to labor management and relations. As a member of BRICS and other economic hubs, South Africa must keep pace with the technologies utilized by its global partners and competitors.

12. RECOMMENDATIONS

- **Evidence-based recommendations on strategies and practices for the use of 4IR and 5IR technologies in building supply chain resilience**

    - ***Strategies in warehousing***

Businesses should have a holistic, end-to-end view that enables decision-makers to make better market-related decisions. In these challenging economic times, it is crucial to maintain visibility of stock at all stages of the supply chain. This supports the operation of a lean and efficient supply management chain, ensuring the right products are delivered in the correct quantities, at the right place, and on time. This approach maximizes sales opportunities and prevents excess capital from being tied up in inventory. For full adoption of these processes, organizations should designate technology champions to advocate for the benefits of the new technology systems.

The strategic positioning of warehouses for faster delivery and reduced costs is the first strategic consideration. Strategically placed warehouses at coastal harbors and regional or satellite distribution centers in close proximity to end users are primary considerations. Consolidation of facilities leads to cost containment. Warehousing can also be accomplished through third-party logistics providers who can offer the same services as an owner. Smaller organizations requiring warehousing facilities can turn to “on-demand” warehousing to secure essential or additional storage capacity as needed.

With the challenges of global warming, the sustainability of warehouses has become a strategic imperative. The aim is to go green and reduce the carbon footprint by utilizing solar technology to meet energy requirements. For example, several Massmart subsidiaries now employ solar panels to support their technology while also providing shade in their carports. Additionally, other sectors are consolidating their warehouses to reduce costs and leverage high-end talent.

Most organizations experience apprehension about replacing legacy technologies and personnel. Therefore, it is important for such organizations to seek technologies that can integrate with their existing systems to avoid disruptions and minimize costs. For organizations still considering how to introduce technology-mediated processes, consulting integrated logistics providers like Maersk is advisable. This can help clarify the business’s logistical needs and priorities, enhancing visibility, improving control mechanisms, and increasing warehousing and distribution efficiency.

Another strategic imperative is creating comprehensive employee training processes that include technical and competency skills to complement 5IR technologies, such as hand-held devices. Employees must be supported in transitioning from manual and repetitive tasks to understanding the benefits of technology, alleviating fears of job loss. Engaging properly with labor representatives is a strategic move that will ensure a smooth transition.

Warehouses need to develop a digital business model that emphasizes that digital transformation is not solely about introducing modern technologies but about implementing changes that drive business efficiencies and improve resource planning to enhance the customer experience. The benefits and risks associated with 4IR and 5IR technologies also warrant closer examination.

A transformational strategy for most W&R organizations is that supply chain directors must now have a seat at the boardroom table. Logistics, which was a silent industry pre-COVID-19, is now a vital component of warehousing and retail technology planning.

Warehousing technologies, including AI, ML, automated tools and vehicles, and smart devices like warehouse management systems (WMS), have enabled real-time tracking of goods and their locations. These innovations are crucial for aligning with various functions, such as forecasting. Consequently, careful planning of warehousing design and layout has become a critical element of strategic planning.

- ***Practices in warehousing***

The practices of an organization are the long-term plans implemented to achieve objectives that reflect decisions made at the strategic level. These practices encompass actions that enhance a company's competitiveness and boost customer satisfaction, ultimately leading to targeted performance outcomes. Several technological interventions have enhanced warehousing by introducing sophisticated WMS and practices that align seamlessly with various functions across the supply value chain, establishing best practices. Below are examples illustrating how technology is transforming warehouses and improving agility.

- ***Inventory management***

Before the introduction of technology-mediated advancements, warehouse employees manually counted each item in stock and entered the figures manually, making the process tedious, time-consuming, and prone to errors and possible manipulation. Cloud computing now allows for real-time access to data. The introduction of GPS solutions helps reduce theft through real-time location tracking of items. Inventory should be aligned with the process of moving goods in and out of the warehouse, whether as inbound goods

from suppliers or outbound goods to customers. These processes can be facilitated by technology-driven tools such as automated guided vehicles (AGVs), conveyor belts, and robotics. Additionally, the use of AI in large warehouses can further enhance operations, as certain AI functionalities can automatically send orders to manufacturers based on sales data and predict future demand based on historical trends. This functionality is particularly essential for global players, whose forecasting and order systems must be accurate to ensure seamless operations. Some electronic data interchange systems enable clients to access direct and firsthand information that informs their planning and needs. Some warehouses have adopted a blended approach, balancing technology and human interaction on the ground, which is the very essence of the 5IR.

- ***Shelving of goods***

Technology is also used to manage shelving plans based on seasonal trends, market predictions, and demands. This information helps warehouses maximize space utilization and optimize route planning for the movement and management of goods.

- ***Safety and security***

Safety and security in warehousing are significant concerns. Technology-mediated tools can enhance safety and security measures. Devices such as cameras, sensors, and alarms assist warehouses in monitoring and preventing safety-related incidents and accidents. These tools can also alert warehouses to potential risks, such as employees not using safety harnesses when working at heights. Advanced technologies in fire alarms and smoke detectors have contributed to a reduction in the number of fires in warehouses. Additionally, warehouses utilize safety and security software to enforce policies and procedures related to training effectiveness

- ***Reduction of overhead costs***

One way to reduce overhead costs is by using drones and robots to augment human work. These technological devices improve process efficiency. Robotic hands can pick and lift heavy objects, reducing physical strain on employees. The packing of goods is enhanced by tools such as voice picking, while some wearable devices increase the speed and accuracy of work, resulting in lower labor costs and reduced employee fatigue. Machine-operated forklifts can access items on demand. Drones, on the other hand, fly between aisles to detect items that are low in stock or not in their assigned slots. Space is utilized optimally, as stock can be piled high where only drones can keep track of it. Drones provide real-time data that can be transmitted to the main data management system. The collected real-time and historical data can give the

business valuable insights and intelligence to plan for the future.

- ***Data and analytics***

Big data and analytics are foundational to warehouse operations and management, offering valuable information and insights linked to key performance indicators (KPIs) such as inventory turnover and customer satisfaction. An automated storage and retrieval system connected to the database streamlines warehousing processes by providing precise reports on stock levels, including goods sold, damaged, or returned. Additionally, data enables real-time reporting on the value of goods in stock as needed.

Warehouse automation and technology improve inventory accuracy and reduce errors, providing insights into business profitability and the ability to adapt to changing demands, environments, and market fluctuations. Data also supports more reliable forecasting, improving warehouse agility and helping to prevent overstocking or understocking. This mitigates storage challenges and the accumulation of backorders, ultimately reducing additional costs.

Furthermore, data plays a key role in optimizing storage and retrieval systems, enabling warehouses to produce dashboards, reports, and projections that empower managers to make informed recommendations. New technologies will enhance decision-making driven by data insights, supporting the long-term sustainability of the sector. Business visibility is also enhanced through the use of integrated systems, providing a comprehensive view of operations.

- ***Picking and packing***

Picking and packing software optimizes strategies for batch and zone management, enhancing both picking and packing processes. This software leverages data analytics to streamline order fulfillment by aligning picking routes with demand frequency and volume, while integrating scanning verification and payment points for improved accuracy and faster delivery. These processes should align seamlessly with inbound and outbound movement of goods. Barcode scanners and sensors at these checkpoints enable warehouses to digitize processes that were previously manual, time-consuming, and error-prone.

- ***Checkout and payment***

Checkout and POS systems have also been enhanced by new technologies and are now linked directly to warehouse inventory. POS systems offer multi-currency payment options, including Bitcoin, and self-service options are available, though they have not gained widespread popularity among customers. Most retail

companies are not currently utilizing ML and do not plan to in the near future, preferring the benefits of direct customer contact, such as the ability to suggest alternatives to ordered goods.

- ***Strategies in retail outlets***

Retail technology has become a key differentiator for many retail businesses. It refers to IT-aided solutions that assist in transforming the way these businesses conduct trade, enhancing their operations. The technology adopted must be user-friendly, secure, and compatible with existing systems. A robust system differentiates an organization from its competitors, providing a competitive advantage that can lead to a larger market share through increased sales efficiency.

As part of their retail strategies, organizations need to explore and make informed decisions about the technology options required to enhance business performance. It is also crucial to study and understand customers before introducing any new technologies. Identifying the target market, along with their needs and preferences, is essential before implementing changes simply for the sake of change. Additionally, businesses should consider who their main customers are, why they should continue to shop at their store, and what distinctive features appeal to them. The strategic placement of brick-and-mortar stores is also vital to attract foot traffic in the area.

Successful retail businesses should aim to create a compelling social media strategy that includes platforms like websites, Facebook, Instagram, and YouTube, focusing on what potential customers can relate to. The website should reflect the expectations of prospective customers, providing all necessary details to make the shopping experience unique. Retailers can leverage computers, relevant software, and operating systems to expedite processes and create alignment across multiple platforms, including e-commerce.

A crucial strategy for retail businesses of all sizes is to adopt a two-pronged approach, using technological advancements for both in-store and online purchasing. This approach seeks to streamline operations and simplify retail processes. Another vital strategy is to invest in up-to-date information technology to manage data and information that support both in-store and online functions. Data collection and processing are essential to retail operations, offering insights that help retailers make informed decisions about customer needs and preferences while enhancing their understanding of consumers and overall business performance.

Another important strategy is investing heavily in inventory control systems. Viewing technology as a cost-reducing approach requires retail outlets to invest in various inventory control systems that help store managers track what is on order, what has been received, what is in the store, and what has been sold, damaged, or returned by customers. Such a system should automatically update the database as goods move from one location to another or between stores. It should also provide data that can be analyzed for various purposes, such as identifying fast-moving items, sizes in the case of clothing and footwear, or quantities for other commodities. Customers should be able to receive real-time confirmation of the availability of products that are not currently on the shelves. An electronic inventory system should enable store managers and other staff to check the inventory held by other stores in different locations and facilitate deliveries as needed. This functionality is already implemented in several retail shops.

Acquiring a robust electronic inventory system will help eliminate over- and under-stocking by making use of the store's sales history to confirm buying patterns, seasonal variations, fluctuations, and customer behavior, both within a single store and across all stores. A good inventory control system can also track theft and monitor staff performance. Additionally, it allows for the verification of pricing and maintains accurate records of margins alongside preferred, optional pricing, or markdowns. The inventory system can also utilize data for statistical forecasting and scenario planning, aiding managers in assessing variables such as just-in-time ordering from suppliers.

- ***Technology-mediated practices in retail outlets***

Retail technology includes several innovative digital technologies that can be used in brick-and-mortar and online shopping activities to enhance both sales and customer experience – from the time customers enter the store or click on the company's website for information to the time they walk out of the brick-and-mortar shop with goods in hand or receive delivery of the same.

Big data offers retailers valuable insights into customer behavior, which has the potential to increase a retail organization's annual value. This information is also critical in formulating strategies and practices for retail outlets to keep up with or overtake their competitors and to plan ahead. Big data can also inform decisions regarding warehouse capacity and processes to ensure optimal performance.

In-store SIM systems record the receipt of goods and can conduct a detailed check of what is in or out of stock. The system can also determine opening stock for each day and reconcile stock at any point in time. Additionally, the system can identify any price discrepancies and errors in pricing, and it can override pricing when necessary. Scanners can be used periodically to check the balance of goods on hand, monitor items

out of stock, order goods with a long shelf life, and communicate with warehouses to order new stock. Grocery items are just a click away and can be collected or delivered to a customer's doorstep in "60 minutes" (Checkers advert) using last-mile delivery services such as Takealot or drones.

In-store security has been improved through visible and discreet CCTV systems at points of entry and exit. All these systems are connected to a reporting system that provides in-store intelligence, informing store managers of daily activities in their stores. Online shopping can now be enhanced by systems that allow shoppers to view available merchandise, and in some instances, AR enables online customers to virtually try on clothing or makeup before making a purchase. More advanced retail outlets now utilize VR and AR, as well as ML, to offer customers 3D visualizations, providing them with an enhanced shopping experience.

5.1.12 Shelving

In some retail stores, shelving is now strategically planned using technology, arranged and rearranged to align with customer shopping habits and preferences. Shelves are barcoded, and items are linked to the in-store information system. Hand-held scanners enable store managers to determine pricing, while aisle planning is optimized through in-store intelligence systems.

5.1.13. POS technologies

POS software is now integrated with data systems for various functions, including stock-taking, weighing fresh produce, determining prices, confirming selling prices through Price Look-Up (PLU) codes, automatically deducting items from inventory, and accumulating loyalty points as part of customer retention strategies.

In the face of unpredictable changes, as was experienced with COVID-19, agility is essential for both warehouses and retail outlets. The sector must avoid being caught unprepared again. Information between the manufacturer, the warehouse, and the retail store must be aided by modern technologies.

- **Significance of this study/ROI**

This research study, which aimed to investigate pre- and post-COVID-19 technology adoption in South Africa's W&R sector, holds significant relevance for the sector and its stakeholders. The study's findings should offer a valuable ROI in several ways, including:

a) Offering readily accessible information on the extent to which developed countries have adopted 4IR and 5IR technologies in their W&R sectors.

b) Enabling South Africa's W&R sector to more effectively plan for a comprehensive adoption of technology-driven strategies and practices.

c) Providing a high-level overview of the progress, or lack thereof, in technological innovation within the sector.

d) Enhancing the university's and W&RSETA's understanding of how best to support the W&R sector in terms of identifying and using the concept of the "Internet of Things", thereby playing a strategic role in promoting technology adoption within South Africa's W&R sector.

The current study on the extent of technology adoption within the W&R sector has provided valuable insights, contributing to knowledge production and offering practical guidelines and solutions based on the findings.

a) If budgets allow, the study should be conducted longitudinally to determine whether the uptake of technology-driven strategies and practices is gaining momentum and to assess the outcomes. It would also be valuable to examine any correlation between early adoption of 4IR and 5IR technologies and the profitability indices of participating companies.

b) Establishing innovation and research offices within organizations looking to introduce or expand the use of technology should be a planning priority. This will enable these organizations to adopt state-of-the-art technologies that have been successfully implemented elsewhere.

c) The TIPS (Technology, Innovation, People & Systems) framework, combined with systems theory, should serve as the foundation for curricula developed by the W&R sector, SETA, and training organizations.

- **Recommendations for enhancing skills development**

- As a strategy to increase technology adoption in the W&R sector, the SETA should focus its training initiatives on scaling up future-ready skills, including:

Table 5: Training interventions recommended to W&RSETA

Cognitive and metacognitive Skills	Practical and Physical Skills	Social and Emotional Skills
-Problem solving & reasoning **- Analytical thinking** **- Critical thinking** **- Self-directed learning** **- Originality** **- Non-routine cognitive** **- Digital literacy** **- Conceptual learning** **- Interdisciplinary learning** **- Innovation mindset** **- Ideation**	- Skills transfer -Adaptation and manipulation of equipment and devices -Assimilation of new knowledge -Technology monitoring and control - Tech design and programming	- Emotional intelligence - Communication - Leadership - Risk evaluation - Collaboration - Accountability - Reflection and evaluation - Decision-making - Ethical judgment - Positive work attitude - Life-long learning

Adapted from World economic forum and OECD Future of Education and Skills 2030 Concept Note 2019

The W&RSETA should assist its members in becoming learning organizations, supported by capacity building for its facilitators and supervisor training within the organizations it supports. The SETA should also aim to close the growing gap between industry and training colleges. The training facilities in Technical Vocational Education and Training (TVET) colleges, technical universities, and other training institutions funded by the SETA must be equipped to reflect the workplace that will employ its graduates. Alongside this effort, the SETA should place greater emphasis on becoming thought leaders in technology adoption and usage, working towards fostering greater collaboration between industry and universities. Additionally, the SETA website should feature information about research being conducted in the field to highlight its importance and relevance.

- **General recommendations**

Organizations under the W&R SETA must combine factors and enablers of their business processes to successfully implement technologies of the 4IR and 5IR. It would be practical for South Africa, as a member of the BRICS countries, to learn from its more advanced partners by planning exchange programs. The sector

must advocate for the introduction of robust technology studies in technical colleges, with the government leading the drive for change. Compliance with regulatory matters is important. A complex landscape of regulations and compliance issues must be navigated by organizations, aided by the SETA. The importance of staying current and compliant with relevant laws and standards cannot be overstated. Additionally, partnerships and collaborations should play a significant role in the sector's strategy, as these will facilitate access to expertise, resources, and innovative solutions from collaboration with technology vendors, universities of technology, and other organizations.

Internally, the organization's vision and leadership are essential. Strong leadership with a clear vision of how these technologies can transform the organization and promote their adoption is crucial for fostering a culture of innovation. Digital strategies must be well-defined to enable optimal operational agility and flexibility. Organizations need to develop a digital strategy aligned with their business goals, outlining how 4IR and 5IR technologies will be integrated into business processes, with the aim of creating a fully integrated system that allows for electronic data interchange. Infrastructure support is essential, as 4IR and 5IR technologies require a robust and scalable technology infrastructure, including cloud computing and high-speed connectivity. Acquiring and effectively implementing new technologies requires adequate funding and thorough evaluation. Organizations must undergo substantial transformations to integrate these technologies, which should be facilitated through effective change management practices.

Developing and maintaining a workforce with the necessary skills and expertise is crucial. Targeted training and upskilling programs should be established to support the adoption of new technologies. Innovation should become an integral part of an organization's culture. Employees should be encouraged to experiment, learn, and develop new or supporting technologies in an environment that fosters continuous innovation. Technology implementation must be included in KPIs and metrics used to assess success and adjust strategies as needed. Risks associated with the use of advanced technologies should be identified and mitigated. Data and systems must be protected from cyber threats through effective security measures. The importance of implementing robust cybersecurity practices cannot be overstated.

Piloting and prototyping are critical factors to consider. Before implementing any technology on a large scale, organizations should begin with small-scale prototypes or pilot projects to reduce the risk of wasteful expenditure. Given the amount of time and energy required to successfully implement 4IR and 5IR technologies, participating organizations should diligently focus on identified enablers to ensure success in the digital revolution.

Organizations investing in new technologies must adopt a customer-centric approach. The importance of understanding the needs and preferences of customers cannot be overstated. By leveraging these new technologies, W&R organizations can create new value for customers and enhance their shopping experiences. Above all, technology implementation should be guided by ethical implications and the environmental impacts they may have. Organizations must subscribe to responsible and sustainable practices.

13. CONCLUSION

In conclusion, this research has demonstrated that organizations in the W&R sector had already begun introducing 4IR and 5IR technologies into their warehousing and retail operations, though at a cautious pace, with larger organizations leading the way. The onset of COVID-19 served as a catalyst, prompting organizations to make substantial investments in AI as an essential innovation and differentiator. The study reveals that not all organizations, particularly SMEs, have fully adopted or invested in AI for future use, often opting for a conservative approach due to the various obstacles and barriers to implementing 4IR and 5IR technologies.

The paper outlines possible strategies and practices to enhance the use of these new technologies. Implementing these recommendations should support and automate both structured and unstructured tasks in warehousing and retail, driving a shift towards customer-centric applications of ML. One significant advantage of big data analysis in technology-enabled operations is that business projections and decisions are now grounded in real-time data, providing a more reliable approach for identifying critical supply chain nodes.

The contribution of this paper is that it provides an overview of the current usage of AI and ML, allowing practitioners and researchers to further analyze which 4IR and 5IR strategies and practices could enhance business practices from an economic perspective and act as indicators of the usefulness and competitiveness of AI and ML applications. Further research could investigate whether there is a correlation between the financial and competitive success of companies that came on board early and those that made a late investment or none at all.

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