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Dynamics of integrating smart technology strategies for harnessing operational performance of state-owned enterprises in public transportation sector in Zimbabwe

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ABSTRACT

The aim of the study was to assess if integrating smart technology strategies in state-owned enterprises' (SOEs) public transportation sector enhances operational performance in Zimbabwe. In this qualitative study, purposive sampling was used to select 20 participants from SOEs. Structured interviews were used to solicit data which then was analysed using thematic analysis and presented thematically. The study results revealed that progressions in smart digital technologies like big data analytics, the Internet of Things (IoT), artificial intelligence (AI), cloud computing, data-driven optimisation, automation and rider-focused design substantially improve efficiency, reliability, safety and sustainability across buses, trains, metros and intermediate public transit for addressing endemic intelligent transportation challenges. Therefore, the study concludes that when the level of ICT usage is high in SOEs, vehicle maintenance, fuel management, driver management, vehicle replacement and service delivery are enhanced. Therefore, further exploration into any area to improve transport services, like fleet management, will have a positive impact on the value chain of essential goods and service. The Government can also develop comprehensive policies and business plans with general performance indicators and individual performance measures for each public ministry.

Key Words: Smart Technology, Operational Performance, SOEs, Public Transport

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INTRODUCTION

Public passenger transport systems play a vital global role through providing mobility and access to jobs, education, and services for millions (United Nations Development Programme [UNDP], 2024). However, issues like poor integration of technological innovations, inefficient routes, overcrowding, lack of real-time information and financial losses plague public passenger transport in emerging economies (The Organisation for Economic Cooperation Development [OECD], 2024). Despite its widespread usage, the sector grapples with chronic inefficiencies that not only impose significant economic costs, but also diminish the overall quality of life for citizens (OECD, 2024). These inefficiencies often result in congestion, delays, and inadequate service provision which, in turn, constrain access to essential services and livelihood opportunities for many residents (United Nations Population Fund [UNFPA], 2024).

The efficient operation of public transport enables the transportation sector to continue playing a very important role in economic development (UNFPA, 2024). To support economic growth, improve accessibility and expand global activities, an efficient public transport service is crucial (OECD, 2024). Additionally, research has established that a good public transportation service is characterised by accessibility that results in reliability, convenience, safety, and intelligence (Goodhall, 2023; Adeniran, 2023; Bianchi, 2023, Adendorf, 2023). Failure to provide quality and efficient public transport services will adversely affect transport systems and ruin travellers' experience. Therefore, public transportation enterprises should evaluate their services to enhance better mobility and connectivity for travellers (Goodhall, 2023; Adeniran, 2023; Bianchi, 2023; Adendorf, 2023).

As the world is on the verge of the Fourth Industrial Revolution (4IR) that is transforming most industries, the transportation sector is also facing sustainable and profound changes (UNFPA, 2024). The transport sector needs to accommodate 4IR technologies to harness operational flexibility to enhance performance (Goodhall, 2023; Adeniran, 2023). Therefore, researchers argue that implementation of 4IR in the transportat industry results in an Intelligent Transportation System (ITS) which has an Intelligent Public Transport System (ITPS) as a subsystem (Adeniran, 2023; Bianchi, 2023; Adendorf, 2023).The main aim of IPTS is to control public transport networks in order to

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maintain their performance and provide users with up-to-date information regarding trips and network operational conditions (Bluglieri, 2022; Nelson &Mulley, 2022). To achieve its targeted aim, Intelligent Public Transport System (IPTS) relies on modern technologies that must be implemented in different areas of public transport systems (Ferris, 2020). Since the transport industry cannot be excluded in 4IR, broader 4IR tools are used for public transport growth and operational efficiency (Ferris, 2020; Vendeschurren, 2020; Nelson & Murray, 2020; Barole, Rout, Goel, Vadagiri & Mathew, 2022). These tools include Internet of Things (IoT), Artificial Intelligence (AI), Big data, Cloud computing, and Blockchain. Under these broader tools are the key emerging transport technologies that can be used to transform the public transportat systems by changing the way travellers interact with the public transit services and increasing operational efficiency by public transport companies (Ferris, 2020, Vendeschurren, 2020; Nelson & Murray, 2020; Barole, Rout, Goel, Vadagiri & Mathew, 2022). Researchers have grouped these technologies in the following categories: traveller's information systems, managing operations and fleet, intelligent vehicle initiatives, electronic payment systems, intelligent vehicle initiatives, and security (Ferris, 2020; Vendeschurren, 2020; Nelson & Murray, 2020; Barole, Rout, Goel, Vadagiri & Mathew, 2022).

A study done by Adediran (2023) in Canada established that by leveraging mathematical models, algorithms, and seamless Internet of Things (IoT) integration, public transport authorities can unlock a multitude of opportunities for data-driven optimisation across various facets of public transport. These include scheduling enhancements, route optimisation, real-time vehicle tracking, predictive maintenance, and informed infrastructure planning (Adediran, 2023). Another research done in Asia by de Caseres, del Olmo and Jimenez (2018) showed that the application of Geographical-Spatial System (GPS) and Geographical Information System (GIS) helps in mapping and following up vehicle progress on routes and locating disturbances on transport networks. GIS helps in analysing traffic flows in order to evaluate and rank vehicle service and transport network designs (de Caseres, del Olmo & Jimenez, 2018). Researchers in France have also found out that implementing the global positioning system (GPS) and state-of-the-art routing technology fleet management strategy by state-owned enterprises (SOEs) significantly

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diminishes travel time and fuel consumption, resulting in optimisation of vehicle use and decreasing carbon oxide (CO2) emissions (Gitahi & Ogollah, 2021; Pedraza-Martinez & Van Wassenhove, 2021; Barone & Decarlo, 2023; Johnson & Scholes, 2023). These sophisticated systems take into account factors like traffic congestion, weather, and the state of existing roads in order to consistently update the most efficient routes, resulting in route optimisation (Gitahi & Ogollah, 2022; Pedraza-Martinez & Van Wassenhove, 2022).

Likewise, Nha et al. (2022) studied route planning in smart cities and found that inefficient route planning and optimisation result in higher transport costs. According to Wang and Zhu (2022), route planning can have a positive impact on the performance of state-owned enterprises (SOEs) in terms of cost reduction and customer service improvement. They add that effective route planning can also help reduce transport costs by minimising the distance travelled, fuel consumption, and vehicle repair and maintenance costs.

Similarly, a study by Van Zandt (2022) found that route planning can improve supply chain performance by reducing transport costs, improving delivery reliability, and enhancing customer satisfaction.

However, there is scant literature in developing countries, but a study by Vanderschuren and Wolter (2017) in South Africa demonstrated that through the application of smart technologies in the passenger transport sector, there was a significant improvement in operational efficiency, reliability, and sustainability. Such optimisation efforts hold the potential to streamline operations, reduce operational costs, and enhance overall service quality for commuters (Vanderschuren & Wolter, 2017). However, even though these studies brought into the limelight the implications of smart technologies to the passenger transport sector, none of them came up with a model to harness operational performance in the context of developing countries, particularly Zimbabwe, which this study sought to address.

However, the significance of efficient and high-quality public transport systems extends beyond mere convenience, significantly impacting productivity, economic growth, and the overall quality of life within cities (Stefanescu, Mocan & Neculai, 2022). By seamlessly connecting workers to job opportunities and students to educational

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institutions, these systems facilitate workforce participation and skill development, driving socio-economic advancement (Stefanescu, Mocan & Neculai, 2022). Effective and efficient implementation of real-time information sharing platforms, trip planning platforms such as electronic maintenance monitoring systems, GPS, automated vehicle location systems, automated passenger counting sensors, electronic fare payment, smart cards, automated collision warning and notification systems and in-vehicle surveillance systems, helps in the growth of the public transport sector and comes along with benefits that include reduced accidents, quick and easy data management, maximised safety and productivity, reduced risk associated damages, reduction in operational costs, boosting efficiency, quality flexibility, as well as passenger and company trust (Ferris, 2020, Vendeschurren, 2020; Nelson & Murray, 2020; Barole, Rout, Goel, Vadagiri & Mathew, 2022).

Additionally, the accessibility provided by public transit networks enhances the resilience of urban economies by reducing congestion, pollution, and the associated costs (Stefanescu, Mocan & Neculai, 2022). As a result, cities with robust public transport infrastructure experience greater economic competitiveness and attractiveness for businesses and investments, further reinforcing their growth trajectories (de Caseres, del Olmo & Jimenez, 2018). Adeniran (2024) points out that this can efficiently be achieved through the use of New-Age technologies that came with the Fourth Industrial Revolution (4IR), yet most developing economies are yet to adopt and implement these technologies due to a myriad of hurdles.

However, state-owned enterprises (SOEs) in some selected African countries are not spared the hurdles of fleet management for sustainable quality service delivery. Despite adopting technology, most SOEs in Mozambique face serious challenges in implementing service delivery options that enhance existing structures towards service delivery (Lavrine, 2022; Fourier & Poggenpoel, 2022; Mutize & Tefera, 2022). In addition, Fourier and Poggenpoel (2023) found that there has been a number of unnecessary purchases of motor vehicles in many SOEs in Tanzania, though those extra vehicles bought do not reflect the exact demand. Correspondingly, the Namibian government has been losing almost 350 motor vehicles every year due to breakdowns as a result of effective maintenance systems in public entities (Controller Auditor

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General, National Audit Office, 2022). Also, the SOEs in Tanzania have been incurring more than four billion shillings (1,725,910.80) United States Dollars), just for fleet purchases and maintenance (Controller Auditor General, National Audit Office, 2022). United Nations Development Programme (UNDP) (2023) observes that state-owned enterprises (SOEs) in Malawi, Zambia, Mozambique and Namibia are also plagued by frequent vehicular breakdowns, accidents as well as poor vehicular scheduling. Assey, Kalegele and Chachage (2021) argue that even though there are laws and policy frameworks governing fleet operations in most developing countries, there is non-compliance to asset management regulations in public entities, as most SOEs suffer from gross mismanagement, corruption and poor service delivery. However, SOEs in most developing nations are plagued by increasing costs in vehicle repair and maintenance, fuel theft, aging fleets, poor vehicle financing and disposal, non-compliance to procurement procedures, and rampant misuse of state vehicles (OECD, 2024).

Researchers have also found out that state-owned enterprises (SOEs) in sub-Saharan Madagascar are also encountering fleet management challenges for enhancing quality service delivery (Nirinarisoa & Razananampa, 2024; Nauki, 2024). The study found out that there is poor vehicle spare parts management and that vehicle faults are not fixed until failure occurs, thus negatively influencing service delivery. The study also indicated that fuel consumption rate, fuel monitoring, and fuel sourcing and allocation have negatively influenced service delivery within SOEs in Madagascar. The study concludeed that lack of driver training and education, lack of regular driver forums, poor recognition and rewarding of drivers have negatively influenced service delivery within SOEs. The study results also found out that unclear procedures for disposal and acquisition of vehicles, lack of procurement planning, little consideration to vehicle life span and abandonment of fleet needing disposal have negatively influenced service delivery in SOEs. The study further established that information communication technology (ICT) fosters a positive relationship between vehicle fleet management practices and service delivery. Therefore, the study concluded that when the level of ICT usage is high in SOEs, vehicle maintenance, fuel management, driver management, vehicle replacement and service delivery are enhanced (Nirinarisoa & Razananampa, 2024; Nauki, 2024). The

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current study, therefore, sought to find a sustainable solution to the challenges bedeviling the public transport sector through coming up with a smart technology model to give passenger transport sector a competitive edge in the contemporary business environment.

However, public transport across Zimbabwe's cities faces a myriad of challenges, ranging from poor integration and connectivity, lack of reliable real-time information, inefficient routes, overcrowding, financial losses, to lack of passenger safety (Finscope Survey, 2020). For instance, the city bus system provided by the Zimbabwe Public Service Commission is the main mode of public transport in most cities but suffers from infrequent schedules, lack of route rationalisation and chronic delays, leading to overcrowded buses and customer frustration (Kanyepe, 2018). Intermediate railway transport modes like ply on arbitrary routes leading to irregular availability. Trains and metro rails suffer from chronic delays and systemic inefficiencies like low frequency, poor last-mile connectivity, unreliable information, and ticketing problems that reduce rider satisfaction (Muchaendepi, Mbowa & Kanyepe, 2018). This is exacerbated by the fact that most Zimbabwean cities lack an integrated public transit network that allows smooth transfers among metro, train, bus and intermediate transport modes. The continued use of technologically-outdated and cost-effective transport systems in Zimbabwe's public transport sector appears to be fuelling corporate failure of parastatals due to unsustainably high operational costs, poor customer response and non-competitiveness at local, regional and national levels (Muchaendepi, Mbowa & Kanyepe, 2018; Mazorodze, 2022). Continuously and appropriately evaluating public transport performance in line with these technologies is a necessity so as to understand and improve the intervening factors for better mobility and connectivity.

As a way of raising revenue and providing essential services to the citizens of Zimbabwe, the Government of Zimbabwe runs several enterprises, wholly owned by it and managed by its agents through selected Board of Directors (Ministry of Transport and Infrastructural Development, 2024).The Government of Zimbabwe also has a stake in the transport industry through the following enterprises: Zimbabwe United Passenger Company (ZUPCO), Civil Aviation Authority of Zimbabwe, Air Zimbabwe Holdings, Central Mechanical and Equipment Department (CMED), National

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Railway of Zimbabwe, Zimbabwe National Road Administration (ZINARA), and Traffic Safety Council of Zimbabwe, to cater for all the sectors of the transport industry, which are road, air and rail networks (Ministry of Transport and Infrastructural Development, 2024). These enterprises dominate the transport industry and are major service providers to the ordinary Zimbabweans, hence their performance is vital to both the government and the general public (Makurumidze et al., 2020).

In Zimbabwe, research on integration of smart technologies in harnessing operational efficiency and focusing of state-owned enterprises (SOEs) lacks a comprehensive strategic model that affects quality service delivery. It is still unclear if benefits that accrue to worldwide SOEs also accrue to Zimbabwean SOEs due to the need to hastely adopt and implement innovative engagement frameworks to harness performance in transport fleet management. Other researchers, therefore, argue that in developing countries, there is no standard meaning when it comes to fleet management in SOEs (Makurumidze et al., 2020). Even though fleet management has emerged as an essential aspect in the business world, very little research on the integration of smart technologies has been carried out to back up the growth of fleet management through developing and implementing a model in Zimbabwe, which this study sought to address. This, therefore, shows that there is a research gap that needs to be filled with appropriate research, which this study sought to address through looking at fleet management at Zimbabwean state-owned passenger transport enterprises, focusing on the National Railways of Zimbabwe (NRZ), Zimbabwe United Passengers Company (ZUPCO) and Central Mechanical and Equipment Department (CMED). These companies have a mandate, from the government, to provide a reliable, affordable and safe service of passenger transport to the general public of Zimbabwe. In order to achieve this goal, the Government of Zimbabwe has vowed to support these parastatals financially and in other ways, as much as it can, so as to better provide this service.

The National Railways of Zimbabwe (NRZ) has faced declining revenue due to aging infrastructure, a shrinking fleet and plummeting cargo volumes, resulting in it operating below 10% capacity utilisation (Rusvingo, 2023). The NRZ has suffered from the general decline of the country's economy. Neglect of maintenance, lack of spare parts and overdue replacement of

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equipment have led to a situation where only part of the network is in good condition. Equipment problems have led to reduced service (Makurumidze et al., 2020). However, there is substantial government involvement in the operational policies of the NRZ, which is not free to take action without specific government approval (Government Fleet Management Report, 2023). In addition, according to the ZUPCO January 2023 report, ZUPCO has a staggering availability of 30%, with less than 50 buses of the 300 fleet operational (Economic Government Watch, 2023). Likewise, CMED is mainly responsible for providing and operating transport services, giving priority to the State. There is evidence of serious inefficiencies at CMED, as targets are not met on all the following indicators: vehicle repairs, acquisition of vehicles for Ministries, and profit (Economic Government Watch, 2023). As a result of these malpractices, service delivery of SOEs has fallen far short of what is required by the economy and the general public (Government of Zimbabwe, Ministry of State Enterprises and Parastatals, 2022). This warrants the development of a framework for integrating smart technology for enhancing the operational performance of these state-owned enterprises in the public transport sector in Zimbabwe, which this study sought to address.

Zimbabwe's state-owned transport enterprises (SOEs) are not sustainable and are underachieving, since they have been recording enormous expenditures and liabilities through the way passenger vehicles are managed, as indicated by more than 30% high expenditure (National Portal of Zimbabwe, 2024). This has been exacerbated by misalignment of practices and strategies, liquidity challenges, dynamic global changes, increased competition, technological changes, vicissitudes in market responses, and regulatory frameworks. This has led to massive reduction of expenditure, as the enterprises could not meet revenue targets due to massive decline in fleet availability, regardless of the injection of funds from state (Ministry of Transport and Infrastructural Development, 2023). Therefore, this calls for the adoption and implementation of smart technologies to enhance the operational efficiency of SOEs in the public transport sector.The SOEs fleet size in Zimbabwe represents over 1% of the total population of vehicles, constituting 11% of Zimbabwe's economy and contributing 40% to the country's gross domestic product (GDP) (Government Fleet Management Report, 2023). Improvements by government

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in efficiency decreases transport costs for all and stimulates further economic development. As a result of these inefficient strategies, service delivery of state owned enterprises (SOEs) has fallen far short of what is required by the economy and the general public. Therefore, this study focused on assessing the effectiveness of adopting and implementing smart technology strategies in enhancing the performance of SOEs in the public transport sector in Zimbabwe.

THEORETICAL FRAMEWORK

The study was underpinned by the Resource-Based Theory (Wernerfelt, 1984; Rumelt, 1984). The Resource-Based Viewpoint (RBV) has an intra-organisational emphasis and contends that firm-specific resources and capabilities influence performance (Wernerfelt, 2008). The Resource-Based Perspective is founded on the idea that competitiveness in the future will be determined by the development of distinctive and unique talents, which are frequently implicit or intangible in nature. The distinctive resources and competencies of the company should be used to develop the core of strategy (Rumelt, 2008). According to the RBV of the company, a firm's operational performance may be attributed to the resources, capabilities, and distinctive operating style that it has access to and control over (Barney, 2001). According to Crook, Ketchen and Combs (2019), organisations may develop and sustain operational success by identifying and controlling internal strategic resources. The emphasis is on the argument that organisations must compare their skills with those of the market, position themselves and their resources, and use their strategies to position their resources in the market. Barney (2010) states that if all businesses had the same resources, there would be no profitability disparities since any firm operating in the same industry could employ any strategy. According to the underlying rationale, the cost of resources and capabilities used to implement the chosen strategy will largely determine how long a competitive advantage will last. The capacity of the company to implement a plan that better meets market demand and increases consumer utility is improved by having more resources. The Resource-Based Perspective may be crucial for fleet management to direct a better, more efficient flow of service delivery. A business should make sure that their fleet is enough and well-maintained so that they can always provide the best service.

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METHODOLOGY

Research Philosophy

The study was underpinned by the Interpretivist research Philosophy because of its qualitative approach. Interpretivism is a qualitative research paradigm that emphasises understanding the subjective meanings and experiences of individuals (Creswell, 2007). This paradigm views reality as socially-constructed and emphasises the importance of understanding individuals' interpretations of their experiences (Saunders, 2009). This paradigm allows for in-depth exploration of participants' perspectives and experiences, as was, therefore, relevant to this study. Data analysis in interpretivism involves thematic analysis or narrative analysis, where researchers identify patterns, themes, and meanings within the data (Saunders, 2009. The researcher interprets the data while considering the context and subjective meanings attributed by participants. This interpretation is often iterative, involving continual reflection and refinement (Saunders, 2009).

Research Design

The study was informed by the qualitative research slant. Qualitative research is a method of inquiry that focuses on understanding human behaviour, experiences, and social phenomena through the collection and analysis of non-numerical data (Saunders, 2009). It aims to provide insights into the meanings, contexts, and complexities of participants' perspectives (Creswell, 2009). This was applicable in this study which sought to infer participants' perceptions on the dynamics of integrating smart technology strategies for enhancing the operational performance of selected state-owned enterprises in public the transport sector in Zimbabwe.

Population

The research population comprised all 20 purposively selected senior administrators, treasurers, chief executive officers, engineers and Town secretaries from National Railway of Zimbabwe (NRZ), Zimbabwe United Passenger Company (ZUPCO) and Central Mechanical Department (CMED).

Sampling Procedure

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Given the qualitative nature of the study, non-probability sampling was employed to choose participants for the qualitative data collection. The purposive sampling approach was employed to choose participants based on their deemed capacity to provide valuable information. Purposive sampling offers advantages like focusing on specific relevant participants, yielding rich, in-depth data, and being more efficient in terms of time and resources, compared to other methods, especially for qualitative research (Saunders et al., 2007). In this study, purposive sampling was chosen because it allows researchers to select participants who are most likely to provide valuable insights into the research problem, ensuring that the data collected are directly pertinent to the study's objectives. By focusing on specific individuals or groups, researchers can gather detailed information and explore nuances and subtleties that might be missed when a more generalised approach is employed (Saunders et al., 2007).

Sample size

The purposive sampling technique was employed to choose 20 principal senior administrators, treasurers, chief executive officers, engineers and Town secretaries from National Railway of Zimbabwe (NRZ), Zimbabwe United Passenger Company (ZUPCO) and Central Mechanical Department (CMED).

Data Collection

The study employed a structured-interview guide. The researchers recorded the conversations on tape for the purpose of subsequently transcribing them word for word. Using one-and-a-half spacing and broad margins, the researchers were able to add written comments and notes to the data acquired from the interviews. It was from the transcripts that the researchers derived key concepts and recurrent themes and ideas. Information about the individuals' backgrounds and expertise was gleaned through one-on-one interviews.

Data Analysis

Thematic analysis was used to analyse the interview data. Researchers can discover, assess, and report meaning patterns in qualitative data through the use of theme analysis (Braun & Clarke, 2006). One benefit of this approach is that it can produce more detailed information on the individuals'

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experiences and their conscious actions. The researchers took a phenomenological stance, as espoused by scholars like Fouche and Pichurink (2011), who contend that context-specific analysis of meanings and broad descriptions of experiences should follow data-systematic determination.

RESULTS AND DISCUSSION

The results of this study were drawn from all 20 purposively selected participants from National Railway of Zimbabwe (NRZ), Zimbabwe United Passenger Company (ZUPCO) and Central Mechanical Department (CMED). However, the researchers reached data saturation and stopped at 12, which translated to 60% response rate. High response rate implies that the matter was of great importance to all stakeholders in this dynamic technological environment aimed at boosting the operational performance of SOEs in Zimbabwe.

Various thematic areas were generated from participants' perspectives on the effectiveness of adopting and implementing smart technology strategies in enhancing the performance of SOEs in the public transport sector in Zimbabwe.

Theme 1: Operational efficiency

All Participants 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 ,11, and 12 underscored that adoption and implementation of smart technology strategies enhance the operational efficiency of SOEs if done according to a designed plan and through engaging all stakeholders, and with resource mobilisation.

Participant 1 asserted:

Our cities have been continually growing at an uncontrolled rate leading to the problem of traffic congestion, which has discernable effects on all the aspects of sustainability, be it social, environmental or economical. This continual shift of increasing size of center and decreasing size of periphery poses huge sustainability challenge of meeting the consumption demands. The advances of human technology have provided its greatest gift of information and communication technology (ICT). Today we have access to data from any point of the world to anywhere. There is a growing need to use this data and information with a holistic view to build more Intelligent Transport Systems in our company.

Participant 2 added:

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Adopting and implementing advanced telematics in transport offers the ability to analyse and monitor every detail of the logistics process. It helps to make proactive decisions that reduce operational costs, increase service levels, and maximize cargo and driver safety.

Participant 3 commented:

Implementing and installation of Automated Vehicle Location Systems using Geographic Position System is crucial strategy in the transport sector. It helps in providing real-time information about the vehicle location in order to inform other stakeholders… AVLs has improved the public transportation systems as it provides users with real-time information concerning the status of the vehicle including monitoring, managing and controlling the vehicle.

Participant 4 revealed:

One of the most crucial emerging technologies in the Industry 4.0 era that is transforming the transportation industry by reducing road accidents is the Collision Warning System (CWS). Advanced systems within Automated Collision Notifications (ACNs) transmit information regarding collision type, number of travelers and likelihood of injuries. This results in quick and improved response times and increased survival chances. It also instils a sense of safety in passengers as they feel if there are quick responses there is a high chance of survival. This technology has been developed to detect and notify the location and severity of a collision to public transport operators and services that are responsible for coordinating emergency response actions.

Participant 6 had this to say:

…there is need to adopt and implement the installation of collision warning systems in the vehicle fleet. This technology is made possible using GPS, GIS and vehicle-to-vehicle communication to provide a live update concerning traffic conditions and after that signals are interpreted. This results in quick and improved response times and increased survival chances. It also instils a sense of safety in passengers as they feel if there are quick responses there is a high chance of survival.

Participant 7 explained:

… in our organisation we have adopted real time integrated strategy system

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for our vehicle fleet. Real- Time Information System (RTIS) as a tool that improves public transport operational efficiency and customer satisfaction. RTIS leads to increased public transportation ridership as it reduces anxiety by users, hence, increasing a sense of reliability towards transportation systems.

Participant 11 argued:

Information and communication technology plays a vital role in the sector of transportation. The ICT market continually launches new applications that support traffic congestion control, transport logistics and transport infrastructure management. In addition to all these ICT has also invaded the new era of transporting information rather than people. The ICT applications have the potential to increase the efficiency of transport networks and decrease the negative externalities, e.g. decrease the congestion and increase the quality of transport networks.

Participant 13 had this to say:

Through the implementation of using The Internet of Things (IoT) strategy, stakeholders are able to interconnects various smart devices (such as smart mobiles, intelligent refrigerators, smart watches, smart fire alarms, smart door locks, and many more) allowing them to communicate with each other and exchange data seamlessly. Smart transportation is the integration of all these benefits into applications for transportation systems. In addition the implementation and application of cutting-edge communications, electronic, and computing capabilities enable information transfer, traffic flow control, and the administration of transportation networks.

Theme 2: Financial performance and revenue generation

Participants 1, 3 and 9 highlighted that adopting and implementation of smart technologies in state-owned enterprises in the transport sector has a positive impact on their financial performance and revenue generation.

Participant 1 had this to say:

... as in our organisation that mobile-based payment platforms increased customer compliance and as such e-payment systems have shown strong potential to reduce revenue leakages which boost

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revenue generation and have a positive impact on our financial performance.

Participant 3 averred:

... similarly, our public bus system experienced a 50% leap in reported revenues following the rollout of mobile payment platforms and fare digitisation. The system also enabled operators to access daily financial reports, thus improving cash flow management and reducing reliance on manual auditing.

Participant 9 revealed:

As in our organisation smart technologies have also contributed to cost containment, another major component of financial performance. The automation of routine financial tasks freed up resources that could be redirected toward core service delivery. These operational savings are indirectly linked to improved financial performance by reducing input costs and enabling more accurate forecasting.

Theme 3: Challenges in adopting digital technologies

Participants 5, 8, 9 and 10 underscored diverse challenges impacting on the adoption of digital technologies by state owned enterprises in public transport sector.

Participant 5 had this to say:

... we have privacy and security risks challenges as state owned enterprises…. the growing accessibility of data and widespread information dissemination pose escalating threats to organisational privacy which may increase their vulnerability to unauthorised exposure or mishandling.

Participant 8 commented:

...although the decentralised nature of block chain technology is seen as an advantage in enhancing data security, practical applications still face privacy protection challenges in our organisations, which limit its widespread adoption in areas such as finance and healthcare state enterprises.

Participant 9 had this to say:

...in as much as we are prepared to adopt and implement technological rigor we are limited with financial woes which is a major hurdle to mull progress in most technological implementation of policies and projects.

Participant 10 averred:

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...the lack of digital literacy has become a key factor limiting the widespread adoption of digital technologies, especially in terms of education, employment and social participation, with obvious negative consequences of limiting the rolling of public projects which may be beneficial to the whole stakeholders.

The study's results were in agreement with literature. Modern technologies in the industry that will rapidly shift all the transport process need accommodate 4IR technologies to engender operational flexibility and enhance performance (Goodhall, 2023; Adeniran, 2023). Researchers argue that implementation of 4IR in the transport industry results in an Intelligent Transportation System (ITS) which has an Intelligent Public Transport System (ITPS) as a subsystem (Adeniran, 2023; Bianchi, 2023; Adendorf, 2023). Since the transportat industry cannot be excluded in 4IR, broader 4IR tools are used for public transport growth and operational efficiency (Ferris, 2020: Vendeschurren, 2020; Nelson & Murray, 2020; Barole, Rout, Goel, Vadagiri & Mathew, 2022). These tools include Internet of Things (IoT), Artificial Intelligence (AI), Big data, Cloud computing, and Blockchain. Under these broad tools are key emerging transport technologies that can be used to transform the public transport systems by changing the way travellers interact with the public transit services and increase the operational efficiency of public transport companies (Ferris, 2020; Vendeschurren, 2020; Nelson & Murray, 2020; Barole, Rout, Goel, Vadagiri & Mathew, 2022). Researchers have grouped these technologies in the following categories: traveller's information systems, managing operations and fleet, intelligent vehicle initiatives, electronic payment systems, and security (Ferris, 2020, Vendeschurren, 2020; Nelson & Murray, 2020; Barole, Rout, Goel, Vadagiri & Mathew, 2022).

CONCLUSIONS AND RECOMMENDATIONS

The study concludes that when the level of ICT usage is high in SOEs, vehicle maintenance, fuel management, driver management, vehicle replacement and service delivery are enhanced. Therefore, further exploration of areas to improve transport services, like fleet management, will have a positive impact on the value chain of essential goods and service. The empirical evidence suggests that smart technology strategies can positively impact the financial

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performance and revenue generation of state-owned transport enterprises. Gains are most pronounced in areas such as electronic fare collection, operational cost reduction, and improved financial reporting. The construction of a regulatory environment and the exemplary role of the government are not only means to address the problems that arise in the process of technology adoption, but also key opportunities to promote the widespread use of technology and the transformation of society. Actively building a regulatory environment that protects user interests and data security while encouraging technological innovation and application can provide a clear direction and reliable guarantee for technological development. However, the realisation of these benefits is highly contingent on implementation fidelity, institutional capacity, and user adoption. For countries like Zimbabwe, a strategic focus on system integration, staff training, and infrastructure investment is critical for maximising financial outcomes from smart technology initiatives in SOEs. The government can also develop comprehensive policies and business plans with general performance indicators and individual performance measures for each public Ministry. Longitudinal studies need to be carried out on the effectiveness of adopting smart technologies in all government sectors in Zimbabwe for proper implementation of policies. Through government demonstration applications, public confidence and acceptance of new technologies can be enhanced while providing enterprises with opportunities for cooperation and pilot projects.

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