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Performance Gap in Information Communication Technology Usage for Vehicle Overload Control at Selected Weighbridge Stations in Tanzania

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ABSTRACT

To ensure precise measurement of vehicle and heavy-truck loads, modern weighbridges enhanced by information and communication technology (ICT) have been established worldwide, including in Tanzania. Their main goals are to prevent accidents, protect road infrastructure, control overloading, and advance socio-economic development. Tanzanian data, however, shows ongoing overloading, indicating a sizable performance disparity in weighbridge operations. This study explores three important aspects of the performance gap at specific weighbridge stations in Tanzania: truck drivers' opinions of weighbridge quality, employees' ability to use ICT for weight measurement, and the technological accuracy of weighbridge systems. The study employed the New Institutional Theory and a qualitative research design to underscore factors affecting weighbridge performance through content analysis and interviews. Results show that even when staff members are sufficiently proficient in ICT, overloaded trucks are routinely permitted to pass, suggesting lax enforcement and unethical behaviour. Furthermore, it was revealed that weighbridge systems frequently produced inconsistent readings due to manual adjustments or variations in truck cargo configurations. The study concludes that ICT competence alone is insufficient to ensure compliance and effective overload control. Regular use of technology, ethical accountability, and institutional integrity are critical for improving weighbridge performance. It recommends strengthening institutional oversight, ensuring that weighbridge technologies function impartially and independently of human or mechanical manipulation, and upholding ethical standards among key stakeholders.

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INTRODUCTION

Controlling vehicle overloading has been a challenge since the 19th century. In the 21st century, international frameworks like the United Nations Economic Commission for Europe (UNECE) have emphasised its importance of protecting infrastructure and ensuring road safety. Tanzania began developing its road network after independence in 1961, establishing initial weighbridge stations to monitor and regulate vehicle weights. These early stations were primarily manual and rudimentary. In response to the demands of modern transportation, the Tanzanian government, supported by international organisations and development partners, invested in modernising weighbridge stations during the 2010s. Digital data management solutions and advanced Weigh-in-Motion (WIM) systems were used in modernisation initiatives (Dayal & Tibebu, 2022; Chen *et al.,* 2020). Effectively monitoring vehicle overloads is crucial for the optimal use and maintenance of road networks. A well-functioning transportation system is essential to national economic growth (World Bank, 2020; Yassenn *et al.,* 2015). By facilitating the movement of goods, raw materials, machinery, and people, it increases industrial and agricultural productivity, expands market access, and creates jobs in both urban and rural areas.

On the other hand, overloaded vehicles pose significant risks to road infrastructure, traffic safety, and national finances. On major Tanzanian routes such as Dar es Salaam–Mwanza and Morogoro–Dodoma, persistent overloading accelerates pavement deterioration, increases maintenance costs for TANROADS and LATRA, and raises accident risk. In countries like Kenya, Zambia, and Nigeria, where inadequate weighbridge capacity and weak enforcement exacerbate road damage and traffic hazards, similar challenges are observed across Africa (Agoro *et al.,* 2024; Chen *et al.,* 2020; Shah *et al.,* 2016; World Bank, 2020).

In Tanzania, weighbridge stations supported by ICT have been established to strengthen the monitoring and enforcement of axle load limits (World Bank, 2021). To analyse axle weight data, TANROADS has introduced automated overloading systems and manages trunk and regional roads (Willcocks, 2013). However, the Weight and Measurement Authority (WMA), which enforces load limits, faces challenges due to limited resources, inadequate coordination, and insufficient technological capacity. Particularly along strategic corridors, these institutional weaknesses have led to persistent overloading, despite regional harmonisation efforts through the East African Community (EAC), the Southern African Development Community (SADC), and the Southern African Transport and Communications Commission (SATCC). There is still a significant performance gap in ICT applications for overload control despite these interventions. The literature highlights issues such as partial automation, antiquated technology, inadequate training, operational mistakes, and ongoing opportunities for corruption or manipulation (Agoro *et al.,* Dayal and Tibebu, 2022; Chen *et al.,* 2024, 2020; Kumar *et al.,* 2019). Thus, several factors, such as organisational and individual capacity, technological efficacy, institutional design, and stakeholder behaviour, are associated with overloading in Tanzania. By methodically examining the performance of ICT-enabled weighbridges, this study aims to close these gaps. It addresses three key objectives: first, it examines weighbridge workers using ICT systems to measure vehicle weight. Second, examines the accuracy and functionality of weighbridge technologies in detecting overloaded vehicles, and finally analyses institutional and behavioural factors, including truck drivers' experiences and enforcement mechanisms, that contribute to performance fissures in overload control. The study begins with a thorough analysis of the relevant literature, which outlines the theoretical framework guiding the investigation. The methodological strategy used to accomplish the study's goals is then explained in more detail. The main conclusions are then presented in a methodical way that aligns with the study's three primary goals. A thorough discussion, conclusion, and summary of the policy implications arising from the findings follow the presentation.

LITERATURE REVIEW

Weighbridge stations are essential institutional facilities for weighing and tracking vehicles, especially commercial carriers and heavy trucks. The main enforcement mechanisms for axle-load and gross vehicle weight regulations are these stations, strategically placed along major highways, border crossings, and important industrial or commercial entry points (Chen *et al.*, 2020; Tibebu & Dayal, 2022). Weighbridge systems use both static and dynamic modalities to function. The conventional method, which requires cars to stop completely for weighing, is represented by the static weighbridge. Personnel with the necessary training must manually verify the vehicle load and documentation using this method.

On the other hand, dynamic weighbridges, also known as Weigh-in-Motion (WIM) systems, enable vehicles to be weighed while in motion, increasing productivity and reducing traffic at weighbridge locations (Jacon, 2010). The incorporation of advanced camera-detection technologies, sensors, and data processors that automatically detect overloading and notify drivers is a more recent innovation. According to Shenzhen Xu *et al*. (2017) observe that these automated systems improve data collection, compliance, and real-time monitoring. In accordance with national and regional frameworks, such as the East African Community (EAC) Vehicle Load Control (Enforcement Measures) Regulations of 2018, the WMA and Tanzania National Roads Agency (TANROADS) work together to implement these technologies to strengthen road transport regulation in Tanzania.

Weighbridge Station Roles and Functions

Protecting public road infrastructure from early deterioration is the main function of weighbridge stations. Culverts, bridges, and pavements are subjected to excessive stress from overloaded vehicles, which accelerates wear and raises maintenance expenses. Weighbridges lower government repair costs and increase road service life by enforcing axle-load and gross vehicle weight limits. Increased transportation reliability and taxpayer cost savings are two additional socio-economic benefits of this infrastructure protection (Kumar *et al.*, 2019; Chen *et al.,* 2020). Second, road safety is enhanced by weighbridge operations. Due to longer stopping distances, mechanical issues, and tyre blowouts, overloaded cars are more likely to be involved in collisions. Weighbridge stations reduce these risks and safeguard drivers, passengers, and pedestrians by ensuring compliance with legal load limits. Thirdly, weighbridges have an ecological purpose. Overloading increases mechanical strain, fuel consumption, and exhaust emissions, worsening air pollution and hastening the depletion of resources. As a result, efficient weight enforcement promotes sustainability and environmental preservation. Lastly, weighbridge data is essential to institutional enforcement and governance. The information helps organisations such as TANROADS, the Police Force, and the WMA identify anomalies, monitor compliance, and track down transporters who engage in illicit activities, such as evading weighbridges or fabricating load documentation.

Regulatory and Legal Frameworks

Overloading is defined regionally by the East African Community Vehicle Load Control Regulations (2018) as the situation in which a vehicle's axle load, group of axles, or gross vehicle weight surpasses the specified legal limits for the vehicle or for any specific section of a public road. According to these rules, when the gross vehicle weight or the allowable maximum axle or axle-unit weight is exceeded, authorised officers may declare a vehicle overloaded.

According to the regulations, the gross vehicle weight must be calculated by adding the individual axle loads (Dayal & Tibebu, 2022). In Tanzania, TANROADS and the Weight and Measures Agency (WMA) jointly enforce these rules. In accordance with the Weights and Measures Act (Cap. 340, Revised Edition 2002), it is essential to guarantee the precision and dependability of measurement tools, such as weighbridges. All weighing devices must be calibrated, verified, and inspected as part of their mandate to ensure compliance with national and international standards. WMA ensures measurement integrity, which boosts the legitimacy of overload enforcement and encourages transporter equity. There are still issues despite these legal frameworks. The WMA has limited technical and human resources, logistical constraints, and difficulties coordinating with other organisations, such as the Ministry of Works and Transport and TANROADS. These restrictions can occasionally lead to inefficiencies, inconsistent data, or delayed calibration of weighbridge equipment, thereby compromising the effectiveness of regulations and the fight against overloading.

ICT Integration in Weighbridge Operations

A paradigm shift in transportation governance and regulation is represented by the integration of information and communication technology (ICT) into weighbridge operations (World Bank, 2020; African Development Bank, 2022). Automated vehicle identification, data-sharing platforms, and electronic ticketing are examples of ICT-based systems that improve accountability, efficiency, and transparency. These systems enable the real-time transmission of weighbridge data to central servers for monitoring and policy decision-making. However, Agarwala (2010) points out that human factors ultimately determine organisational performance. The effectiveness of weighbridge operations depends on what operators do or do not do, even in highly technologically advanced environments. Without qualified, driven, and morally upright staff, even an advanced ICT infrastructure is insufficient. Academics like Thapa et al. (2017) and Shoaib *et al.* (2017) stress that how well technologies are used to accomplish institutional goals depends on employees' knowledge, dedication, and adherence to ethical standards. In this sense, WMA's responsibility extends beyond calibration and verification; it must ensure that operators have the necessary training to use ICT systems correctly and reliably. Data manipulation, bribery, and a decline in public confidence can result from inadequate training, low motivation, or corruption among operators. Therefore, increasing WMA's institutional capacity is essential to effectively using ICT to combat vehicle overloading.

Institutional Effectiveness and Employee Performance

The effectiveness of Tanzanian weighbridge operations is inextricably linked to the performance of the personnel responsible for them. Employee performance, as defined by Deadrick and Gardner (1997), is the observable results of individual job functions over a given time period. According to Darden and Babin (1994) and Mathias and Jackson (2009), it is the efficient accomplishment of tasks to management's satisfaction while adhering to standards and contextual limitations. Three dimensions can be used to conceptualise employee performance in the context of weighbridge operations: (1) cognitive, knowledge and skills in using ICT systems; (2) normative, employees' willingness and ethical concern to apply ICT tools correctly; and (3) regulative, compliance with established policies, procedures, and standards (Muya, 2019). The credibility of enforcement actions and the dependability of weighbridge results are determined by these three factors taken together. Due to bureaucratic inefficiencies, a lack of incentives, and the politicisation of appointments, Tanzania's public sector has historically struggled to recruit and retain qualified employees (Haque, 1994; Mutahaba, 2018). As a result, despite rising demands for service quality and accountability, organisations like the WMA and TANROADS find it difficult to sustain optimal performance levels. Inadequate funding, outdated equipment, and corruption risks at certain weighbridge stations exacerbate the performance dilemma (Brook *et al,* 2006).

Perspectives on Institutions and Governance

The institutional theory provides a helpful framework for understanding the performance dynamics of weighbridge operations in Tanzania. Organisational behaviour is governed by formal rules, informal norms, and enforcement mechanisms found in institutions (Palthe, 2014). According to this viewpoint, the institutional environment that influences incentives, accountability, and compliance is just as important to the efficiency of weighbridge operations as technological inputs and human performance. The WMA's institutional capacity directly influences weighbridge governance. WMA promotes a culture of legality and accountability by efficiently calibrating and certifying equipment, ensuring compliance, and imposing penalties for non-conformance. However, institutional flaws that allow unethical behaviour include overlapping mandates, poor interagency coordination, and bureaucratic delays. Sustainable overload control thus depends on strengthening institutional frameworks through reforms, resource allocation, and improved interagency cooperation.

Theoretical Framework

Institutional theory provides a fundamental understanding of how institutions influence organisational behaviour, structures, and performance, with its roots in the writings of early theorists such as Émile Durkheim, Max Weber, Thorstein Veblen, and John R. Commons (Scott, 2004). The theory has undergone several phases of development, with the New Institutional Theory (NIT) emerging as a modern development. The new institutional perspective, advanced by academics such as Meyer and Rowan (1977), DiMaggio and Powell (1983), and Scott (1995), broadens this focus to include cultural-cognitive processes, social norms, and shared beliefs as crucial determinants of organisational action. In contrast, the classical institutional theorists concentrated on formal rules and authority structures as determinants of behaviour. The New Institutional Theory, which emphasises how institutions, defined as long-lasting systems of social norms, rules, and beliefs, shape and limit the behaviour of people and organisations, serves as the foundation for this research (Scott, 2014). According to the theory, organisations follow institutional pressures not just for technical efficiency but also for legitimacy, stability, and survival. According to Scott (1995), institutional frameworks are supported by three pillars: the normative, cognitive, and regulative pillars. Together, these pillars explain how institutional pressures, both internal and external, affect organisational behaviour.

The formal structures of control that govern and restrict organisational behaviour through rules, regulations, policies, and sanctions are represented by the regulative pillar (Scott, 1995). In line with the findings of Barnett and Carroll (1993), who contend that institutional change frequently occurs through coercive means such as government policies, market regulations, and formal sanctions, this approach emphasises compliance, enforcement mechanisms, and accountability. Because weighbridges are subject to strict legal and policy frameworks that specify acceptable axle loads and vehicle weight limits, the regulative pillar is especially pertinent to Tanzanian weighbridge stations. Effective performance has been compromised, nevertheless, by inconsistent policy enforcement and inadequate accountability systems. Regulatory compliance is overseen by the Weighbridge and Measurement Authority (WMA), which has frequently faced challenges such as inadequate ICT infrastructure, corruption, and limited enforcement capabilities. These gaps hamper the successful application of ICT and operational efficiency in regulation and policy coherence.

To ensure compliance and performance improvement at weighbridge stations, a robust regulatory framework backed by explicit sanctions and oversight remains essential (Jabir & Kamugisha, 2021; Palthe, 2014).

In contrast, the normative pillar is based on social norms, values, ethics, and professional standards that specify what individuals and organisations should do (Selznick, 1948; Scott, 1995). This pillar emphasises how cultural norms, professional codes, and moral obligations impact behaviour. Employees' work ethics, values, and professional standards influence their responsiveness to ICT use and their adherence to protocols in the weighbridge setting. According to Selznick (1948), social obligations are the moral foundation of institutions; therefore, what is morally right or appropriate in one social setting might not be in another. Weighbridge operations throughout Tanzania have shown evidence of misconduct, corruption, and inefficiency due to a lack of strong ethical standards or professional values. Therefore, encouraging ICT adoption and maintaining compliance within weighbridge operations requires strengthening the moral and ethical aspects of organisational culture through training, leadership, and accountability.

According to Powell and DiMaggio (1991) and Scott (1995), the cognitive pillar concerns shared beliefs, knowledge systems, and mental models that shape how people perceive and respond to institutional realities. It highlights the fact that behaviour is inherently influenced by internalised conceptions of what constitutes acceptable and significant behaviour, in addition to external factors such as social standards. The degree of ICT integration and performance outcomes in weighbridge stations is greatly impacted by employees' cognitive comprehension of ICT systems, their perceived utility, and their willingness to innovate. According to cognitive theorists, institutions endure because members of the organisation take them for granted and they are ingrained in their collective consciousness. ICT functions are therefore underutilised or poorly managed when employees lack knowledge or training about them, thereby prolonging inefficiencies. On the other hand, a culture of adaptation and long-term performance improvement can be fostered by cognitive readiness, which is fuelled by training, innovation, and institutional learning (Palthe, 2014).

The regulative, normative, and cognitive pillars work together to shape institutional behaviour and impact organisational change dynamically. Institutions are both stable and dynamic, according to Scott (2014), because they confer legitimacy and meaning while simultaneously adapting to environmental and technological changes. The integration of ICT systems in the Tanzanian weighbridge context reflects an institutional transformation process that depends on shared knowledge and innovation capacities (cognitive), professional and ethical standards (normative), and formal regulations (regulative). Thus, the New Institutional Theory provides a thorough framework for comprehending how institutional enablers and constraints affect ICT adoption and performance.

Empirical Reviews

An empirical review of research on vehicle drivers' perceptions of overloading and its control mechanisms, employees' knowledge and proficiency in using information and communication technology (ICT) for vehicle weight measurement, employees' opinion toward ICT adoption in improving performance in weighbridge departments, and their adherence to ICT-related rules and regulations is discussed in this section. The review concentrates on findings from Tanzanian, regional, and international research, especially from three weighbridge stations in the Morogoro Region. Research from several nations shows that vehicle overloading remains a widespread problem, addressed in various ways. Kumar *et al.* (2019) found that although the majority of research focused on enhancing weighbridge equipment, many of these technologies fell short of achieving full accuracy in weight measurement. Likewise, Zhou Libo *et al.* (2018) investigated the Intelligent Truck Monitoring and Detection (ITMD) system, which uses cutting-edge technology to

identify overloaded trucks, in a study carried out in China. Even with its creative design, the system's accuracy was below 90%. In a related endeavour, Kattimani *et al*. (2017) developed a vehicle overload detector to reduce the harm caused by overloaded cars on the road.

Additionally, Xu *et al.* (2017) created a passenger vehicle overload control system that uses AT89C51 microcontrollers and sensor circuits to control fuel injection in response to passenger load. Compared with conventional methods, the system drastically reduced labour, material, and financial costs, even though it was not entirely accurate. Other researchers have proposed using GPS and GSM technologies for Weigh-in-Motion (WIM) systems, logistics management, and vehicle load balancing and tracking (Kumar *et al.*, 2019). Between 40 and 70 per cent of all trucks are overloaded during peak hours, according to studies from China, Indonesia, and Malaysia (Chen *et al.*, 2020; Jihanny et al., 2018; Kumar *et al.*, 2019). According to reports, overloading costs the Indonesian government about USD 43 trillion a year, while road pavement construction is estimated to cost USD 26 trillion each fiscal year (Kinasih *et al.*, 2020). Similar results from Malaysia, Thailand, China, South Africa, Pakistan, and Taiwan verify that overloading plays a major role in the quick degradation of infrastructure and road pavements (Endut & Ph, 2015).

A Namibian study conducted by Agoro *et al.* (2024) evaluated the degree of heavy vehicle overloading and the efficacy of current mitigating strategies. Of 1,642,254 heavy vehicles weighed between 2015 and 2019, 218,546 (13.3%) exceeded the allowable weight limit, according to the study, demonstrating ongoing difficulties in enforcing weight regulations. Achmad *et al.* (2013) also examined how computerised weighbridge systems affected worker performance and found that ICT-based systems improved data accuracy and operational efficiency. The study noted that these improvements were compromised by corruption and a lack of institutional accountability. Derick (2016) investigated how ICT affected employee productivity and vehicle control at weighbridge stations in East Africa. The results showed that ICT use enhanced worker performance and enforcement effectiveness. However, they also highlighted issues such as poor ICT infrastructure, a shortage of technical staff, and a lack of training materials, all of which hindered efficient overload control. Studies on truck drivers' awareness and behaviour consistently show low levels of compliance and little understanding of the consequences of overloading a vehicle. In their research on the Central Corridor of the Southern African Development Community (SADC) region, Chibira and Mdlankomo (2015) identified several obstacles to cross-border road transportation, including high operating costs, poor infrastructure, inadequate corridor management systems, frequent accidents, and environmental degradation. To enhance heavy vehicle monitoring and control, computerised systems were installed at several Traffic Control Centres (TCCs) in South Africa. Road transport services in Tanzania face several difficulties, including poor infrastructure, outdated weighbridge equipment, and lax enforcement procedures, according to Mporogomi (2001). The persistence of vehicle overloading is largely due to these factors, exacerbated by truck drivers' lack of discipline, employees' inadequate ICT knowledge, and car owners' disregard for the law.

Conclusively, empirical research highlights the complexity of the vehicle overloading issue. Although technological advancements like ICT-based weighbridge systems and WIM technologies have increased monitoring capacity, human factors like corruption, low employee competency, lax institutional enforcement, and resistance to technology adoption undermine their efficacy. Therefore, in addition to investing in technology, sustainable solutions also require capacity-building programs, more stringent enforcement of policies, and a shift in how road users and transportation operators behave.

METHODS

To investigate the performance gap in the use of Information and Communication Technology (ICT) for controlling vehicle overloads, this study employed a descriptive cross-sectional case study design. This observational approach enabled the systematic collection of data from a defined population at a specific point in time, yielding detailed insights into the operational and behavioural challenges at selected weighbridge stations in Tanzania. The study concentrated on stations along busy trunk roads with heavy freight traffic, where overloading is a frequent and enduring problem. Three strategically important weighbridge stations in the Morogoro Region, Mikese, Mikumi, and Dakawa, were purposively selected due to their critical roles in facilitating regional and domestic trade. The central corridor that connects key regions and East African Community (EAC) countries is connected by Mikese and Dakawa stations. In contrast, Mikumi station serves as the main route for trucks transporting goods from the Dar es Salaam port to Zambia and Malawi. Because of their strategic importance and high traffic, these stations were able to provide a representative and diverse sample of respondents with direct experience with overload issues.

In all, 29 respondents were involved in the research. Four employees or station workers were deliberately selected from each station, based mainly on work experience, for a total of 12 weighbridge staff. Furthermore, because of their vast experience transporting heavy loads along these routes, five heavy truck drivers per station were chosen by accident sampling, for a total of 15 drivers. Additionally, a staff member from the Weight and Measurement Authority (WMA) was specifically chosen for his/her proficiency in axle load enforcement, as was a TANROADS management staff member responsible for weighbridge operations and road infrastructure. Interviews focused on participants' experiences and perceptions regarding ICT use in weighbridge operations, the accuracy and functionality of weighbridge technologies, drivers' experiences with overload regulations, and institutional challenges affecting enforcement. This approach ensured a comprehensive understanding of the factors contributing to the observed performance gaps in vehicle overload control in Tanzania.

RESULTS

The findings were presented and analysed based on the study's specific objectives: to explore the employees' capacity to use ICT in measuring vehicle weights at the weighbridges in Morogoro region, to examine the capacity of the weighbridges to appropriately measure the required weight through the use of ICT, to document vehicle drivers experiences towards the use of ICT in controlling the problem of vehicle overloads in Morogoro Region.

Employees' Capacity in Using ICT

Given the overloading quandary in Tanzania, the sub-section intended to examine employees' capacity to use Information Communication Technology (ICT) to measure vehicle loads at selected Weigh Bridges stations in the Morogoro Region. The idea behind it was the incompetence of weighbridge operators in using ICT to determine truck weights that do not surpass the required one. The findings revealed that weighbridge operators could accurately measure the required vehicle weights using ICT. It is because most respondents commented that there was no doubt about the capacity of the weighbridge's operators to measure vehicle weights. One of the interviewees at Mikese reiterated that:

> One of the criteria for selecting new employees to operate these machines is computer literacy (ICT), coupled with related experiences from any organisation with similar experiences. Many weighbridge operators are computer-literate and have sufficient practical experience with Information and Communication Technology to measure the weights of heavy vehicles, including trucks, and related issues. *(employee at Mikese work station, April 2023)*

The interview revealed that employees, regardless of their level of ICT knowledge, face many problems because overloaded trucks continue to use the roads. A reflection of answers accorded by another respondent on the capacity of operators, by pointing out that:

> Although weighbridges may detect overloads, unfaithful weighbridge operators may still allow such trucks to proceed and cause detrimental effects on roads and people's properties. So, knowing ICT is essential. Still, it is imperative to recognise that ICT experts cannot act solely as a control measure against overload unless ethical issues are instilled in both management and the frontline staff. *(Employee at Mikumi work station, May 2023)*

The above insights generally align with many views from weighbridge managers, who acknowledged that weighbridge departments are familiar with operators who are competent in ICT and who, from time to time, are trained to adapt to new changes so they do not become obsolete. On the other hand, the weighbridge operators acknowledged that they had the relevant knowledge and skills to use technology to disclose truck weights. Similarly, truck drivers appreciated the competence of operators. However, truck drivers noted aspects that make operators blind to allowing overloaded trucks' cargo to proceed, regardless of its detrimental effect on the roads. One of the truck drivers commented that;

> Operators' blindness is a function of several factors, including an individual's perception of overload, organisational motivation, and the politics of truck owners, some of whom are system members. Individuals (operators) typically get tips from drivers to let them go with overloaded luggage, sometimes because of institutional failure to compensate them well enough to meet their goals. Surprisingly, vehicle owners influence the management. Finding particular trucks treated differently from others is always the case. *(*truck driver at Mikumi May, 2023*)*

It implies that competent weighbridge operators are insufficient unless the legal framework is enforceable and the management motivates employees using carrots and sticks. In performance management, the 'carrot and stick' approaches refer to a strategy that uses a combination of rewards ('carrots') and punishments ('sticks') to motivate employees and influence their behaviour. Carrot means rewards in terms of incentives (i.e., bonuses, promotions, or other financial returns), recognition related to public acknowledgement, awards, or other forms of recognition for good performance, opportunities for career advancement, professional development, or desirable assignments, and benefits covering additional perks such as flexible working hours, extra vacation days, or other non-monetary benefits.

The stick may refer to punishment that shapes behaviours from bad to good. Examples of punishment in this context may entail disciplinary actions, demotions, terminations, and negative feedback. Disciplinary actions reflect warnings, reprimands, or formal notices for poor performance or misconduct. Demotions mean reducing an employee's rank or responsibilities due to underperformance. Termination is the last resort for persistent poor performance, and negative feedback reflects constructive criticism or performance reviews that highlight areas for improvement.

In interviews, some managers at selected weighbridge stations and representatives from the respective authorities (e.g., WMA and TANROAD) indicated that overload issues are rampant and that they are taking deliberate measures to address them. One of the managers from TANROAD acknowledged that some of the strategies used by the government are to punish (use a stick) truck drivers and owners of vehicles who exceed the loading capacity after being detected at weighbridges, as elaborated hereunder:

> In Tanzania, drivers and owners of vehicles exceeding the loading capacity face significant penalties under the East African Community Vehicle Load Control Act, 2016. The actions include fines and penalties, vehicle detention, and legal prosecution. The fines can vary based on the extent of the overloading specified in the regulations. Vehicles found to be overloaded are subject to hefty fines. Specifically, the law stipulates a fine of USD 15,000 or approximately 35 million Tanzanian Shillings. In addition to penalties, offenders may face a three-year jail term or both. Another way is the immediate offloading of excess weight at the weighbridge. The vehicle cannot proceed until it complies with the legal load limits. If the fine is not paid, the vehicle may be detained until the fine is paid and the load is reduced to legal limits. It can result in delays and additional costs for the vehicle owner (TANROAD official, Morogoro station, May 2023).

In sum, employee capacity in ICT is essential for detecting vehicle overloading; however, institutional factors often undermine its effectiveness. Institutional theory suggests that organisational norms, regulatory weaknesses, and external pressures significantly influence weighbridge operations beyond individual competencies. Scott (2014) emphasises that institutional isomorphism fosters informal practices, such as corruption, which override technical skills. DiMaggio and Powell (1983) outline three types of isomorphism that shape institutional behaviour: coercive, mimetic, and normative. Coercive isomorphism occurs when weak enforcement of transport regulations leads to leniency in controlling overloading. Mimetic isomorphism results in weighbridge operators imitating existing informal practices, such as accepting bribes, reinforcing corruption as a norm. Normative isomorphism emerges through professional socialisation, encouraging even well-trained employees to conform to systemic inefficiencies. North (1990) similarly argues that both formal and informal constraints shape behaviour, leading to inconsistent law enforcement. While Tanzania's transport policies aim to regulate overloading, frontline implementers, such as weighbridge operators, frequently fail to enforce them. The World Bank (2021) highlights governance weaknesses rather than ICT capacity as the primary challenge in effective weighbridge management. Thus, institutional pressures, systemic inefficiencies, and organisational inertia often outweigh individual employee expertise in enforcing load limits.

Capacity of Weighbridges to Measure Vehicle Weights

This part examined the capacity of selected weighbridges in the Morogoro Region to measure required vehicle weights using ICT accurately. Information on the attitudes of vehicle drivers and weighbridge operators towards the use of ICT to address the problem of vehicle overloading was imperative. Most respondents indicated that the government has deliberately tried to respond. One of the WMA people pointed out that;

> The capacity of weighbridges to measure vehicle weights in Tanzania using ICT has significantly improved over the years, primarily through the implementation of modern, automated systems and the enforcement of stringent regulations under the East African Community Vehicle Load Control Act 2016.

> Automated weighing scales have been installed to ensure accurate, efficient measurement of vehicle weight. This modernisation has helped in reducing human error and potential corruption. With the installation of modern weighbridges, Tanzania can handle a high volume of vehicles daily, ensuring that traffic flow is not significantly disrupted while maintaining strict control over vehicle weights. It is imperative to note that weighbridges can measure the various configurations and capacities of vehicles, including those with super single tyres, with specific axle weight limits reduced from 10 tonnes to 8.5 tonnes under current regulations. *(WMA employee, April 2023)*

This study is relevant to the survey conducted by Wihan de Wet. Eileen Koekemoer (2016) indicates that South Africans are stuck in an incessantly linked routine, a condition in which data use, information, and communication technology (ICT) are perceived positively by employees who would use these strategies even for message drives, data distribution, and Internet access. Based on the statement above, Tanzania has modern weighbridges to determine weight, making one believe that cheating is not easy. However, the responses from drivers and operators indicate something worth noting. The operators interviewed many of them, showing that weighbridges can measure vehicle weights when skilled operators operate them. Operators' and managers' responses raise a fundamental question: why do some drivers adjust their weight before reaching such stations? Several drivers interviewed from selected bridges raised the issue of adjusting the weight. One of the truck drivers pointed out that;

> My experience in the transportation business indicates that there is a relationship between arranging or adjusting cargo and releasing it without an accurate weight being recorded. When the same cargo is not adjusted, overloads often become common. Adjusting weight is what many drivers do. We know that the available technology used to detect vehicle carriage capacity or weight can be faked by putting cargo in search of a way to cheat the system (truck driver at Dakawa, May 2023).

The relationship between cargo arrangement and weighbridge weight determination highlights the weak performance of weighbridges. Zhou et al. (2018) acknowledge efforts to detect overloading but note that no system is entirely foolproof. Institutional theory explains this challenge, as mimetic isomorphism (DiMaggio & Powell, 1983) suggests that truckers manipulate cargo to mislead weighbridges. Coercive isomorphism allows weak enforcement and regulatory gaps to persist. North (1990) emphasises that formal regulations alone cannot prevent overloading due to systemic inefficiencies. Despite technological improvements, institutional inertia and governance challenges undermine weighbridge effectiveness, proving that technology alone cannot solve the overloading issue (World Bank, 2021).

Vehicle Drivers' Experiences on Overloads

This subsection examines drivers' attitudes towards using ICT to address vehicle overloading in the Morogoro Region. Regarding that objective, many responses were received from operators, management, and drivers. Meanwhile, weighbridge operators' responses centred on the penalty imposed on drivers who tended to overload. Drivers' responses covered their perceptions of using the weighbridge and the reasons behind their behaviour of adjusting luggage/passengers before entering a weighbridge. Many drivers interviewed responded positively to the use of ICT to reduce vehicle overloading. Most drivers who were asked about this issue said they adjusted their luggage to balance. One of the trucker drivers at Mikumi pointed out that;

> We usually adjust the luggage because, as the vehicle moves, it tends to shift forward and backwards, causing maximum pressure at the front or back of the car. Whenever the vehicle enters the weighbridge platform, it is found to be overloaded. *(*truck driver at Mikumi May, 2023*).*

This point is likely positive, as the cargo adjustment tends to fool the weighbridge and prevent it from accurately measuring the weight. Another truck driver at Mikese almost put it the same but in a different fashion and conceptualisation by saying that;

> We adjust luggage because we are not sure of our vehicle's weight, and there are no mechanisms to check whether the luggage is within the standard weight limit before we start our journeys. Therefore, there should be a specific mechanism in every company's office that indicates the weight of the vehicles before a journey begins. Consequently, we drivers fear being penalised whenever our cars are overloaded. We try to adjust luggage to maintain equilibrium and escape these fines *(*truck driver at Mikese, April 2023*).*
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The manipulation of cargo arrangements by drivers to evade weighbridge detection highlights institutional weaknesses in the enforcement of vehicle weight regulations. Drivers, seeking to avoid penalties and maximise profits, adjust cargo distribution to mislead weighbridge systems. While weighbridge operators acknowledge penalties, the effectiveness of these measures is undermined by inconsistent enforcement and corruption. Institutional theory, particularly mimetic and coercive isomorphism (DiMaggio & Powell, 1983), explains how drivers imitate informal practices to deceive weighbridges and how weak regulatory enforcement allows such practices to persist. North (1990) argues that informal constraints often shape behaviour more effectively than formal regulations. Furthermore, widespread bribery among weighbridge operators weakens enforcement, as drivers do not fear being caught. The World Bank (2021) identifies governance challenges as the primary barrier to effective weighbridge management, with systemic inefficiencies perpetuating overloading and road damage and undermining transport policies.

DISCUSSION

This discussion highlights the regulative, normative, and cognitive pillars that shape the performance gap in the use of information and communication technology (ICT) for vehicle overload control at Tanzanian weighbridge stations. It applies New Institutional Theory to interpret the study's findings. Overloading persists despite technological advancements, driven by institutional flaws rather than technical constraints.

Weighbridge operations are based on the regulative pillar, which includes laws, regulations, and enforcement procedures. The Weights and Measures Act of Tanzania (Cap. 340, Revised Edition 2002) and the EAC Vehicle Load Control Act (2016) establish precise guidelines for the loading and enforcement of vehicles. However, compliance is compromised by inadequate oversight, a lack of accountability, and political meddling. Despite having received ICT training, many weighbridge operators fail to strictly enforce regulations strictly, indicating weak institutional oversight and discipline. While North (1990) highlights that weak regulatory institutions impede economic efficiency, Palthe (2014) contends that institutional performance depends on the strict enforcement of formal rules. The Weight and Measures Agency (WMA), tasked with ensuring the precision and calibration of weighing devices, faces significant obstacles, including insufficient funding, insufficient personnel, and poor coordination with TANROADS. These institutional constraints hamper its capacity to regulate effectively. Informal practices such as favouritism and bribery

undermine formal mechanisms. This supports North's (1990) claim that when formal regulations clash with informal norms, institutions fail. Ethics, professionalism, and common moral principles are all part of the normative pillar. The results show that although ICT skills exist, system integrity is hampered by ethical deterioration and subpar professional behaviour. The legitimacy of ICT interventions is undermined by certain operators who conspire with drivers to fabricate weights. While Scott (2014) notes that moral decay undermines institutional legitimacy, Selznick (1948) points out that moral integrity is essential to institutional survival. In Tanzania, unethical leadership, low compensation, and insufficient recognition foster corruption, undermining the intended benefits of ICT. An ICT application is also impacted by the cognitive pillar, which involves shared understanding and beliefs. Many employees and drivers are unaware of ICT's role in preserving infrastructure and improving road safety.

According to Powell and DiMaggio (1991), institutions thrive when members absorb common meanings. However, underutilisation of ICT systems results from drivers' and operators' low cognitive engagement and cultural resistance to technology. According to Scott (1995), all three pillars must be in harmony for an institution to be effective. These pillars operate independently in Tanzania, leading to disjointed coordination among TANROADS, WMA, and other stakeholders. As a result, despite ICT modernisation, institutional reforms have not produced the anticipated results.

In conclusion, institutional rather than technological flaws are the reason why vehicle overloading persists. ICT usage inefficiencies are sustained by lax regulatory enforcement, moral compromise, and low cognitive awareness. Effective overload control requires bolstering WMA's capabilities, encouraging moral behaviour, and raising public awareness of the advantages of ICT. To achieve long-lasting change, institutional transformation requires coherence across regulative, normative, and cognitive dimensions, as Scott (2004) highlights.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study investigated the performance gap in the application of information and communication technology (ICT) for vehicle overload control at selected weighbridge stations in Tanzania's Morogoro Region. The results show that although ICT-supported weighbridge systems have made a substantial contribution to monitoring and controlling vehicle loads, institutional, technical, and behavioural factors continue to limit their overall efficacy. Modern weighbridge technologies have increased operational efficiency and data accuracy. However, their potential impact is still undermined by enduring issues such as corruption, lax enforcement, poor ICT infrastructure, and low employee motivation. Furthermore, unethical behaviour and systemic governance flaws frequently undermine the enforcement of vehicle load regulations, even when weighbridge operators possess adequate ICT competence. Similarly, truck drivers' propensity to bribe weighbridge operators or tamper with cargo arrangements to avoid fines reflects institutional inefficiencies and a lack of accountability on the part of regulatory bodies. Therefore, the continued prevalence of vehicle overloading in selected areas in Tanzania is more a reflection of institutional and behavioural flaws than of a lack of technology.

Summing it all up, a comprehensive strategy that incorporates institutional reform, ethical enforcement, technological advancement, and behavioural modification is needed to close the performance gap in ICT usage for overload control. Sustainable road protection and better adherence to axle load regulations require strengthening the Weight and Measures Agency (WMA), enhancing coordination with TANROADS, and encouraging moral behaviour among weighbridge employees and truck drivers.

Policy Implications

The results of this study have important policy implications for improving ICT performance and controlling vehicle overload at weighbridge stations in Tanzania. Although the results show gaps in implementation, institutional integrity, and accountability, they are consistent with current national and regional frameworks. The National Transport Policy (2003, updated in 2016) emphasises the use of ICT to improve road safety and transportation efficiency. However, this study shows that inadequate ICT governance and lax enforcement have limited effectiveness. Similarly, axle-load compliance and uniform enforcement across member states are required by the Vehicle Load Control Act (2016) and the East African Community (EAC) Vehicle Load Control Act (2016). However, persistent overloading suggests inadequate coordination and data integration among accountable organisations, such as TANROADS and the Weights and Measures Agency (WMA).

The National ICT Policy (2016) encourages transparency and digital transformation in public institutions. Results indicate that although ICT tools are available, their influence is diminished by staff incompetence and manipulation, necessitating ongoing ethics and ICT training. The Roads Act (2007) empowers TANROADS to protect road infrastructure, but the study reveals persistent non-compliance and system interference, implying the need for impartial monitoring systems and inter-agency collaboration. Additionally, the National Anti-Corruption Policy (2007) and the Public Service Act and Code of Ethics (2005) both place a strong emphasis on accountability and integrity. However, unethical behaviour at weighbridges compromises these principles. Generally, it is acknowledged that compliance cannot be guaranteed by ICT proficiency alone. Effective performance requires integrating technological innovation with strong institutional ethics, regular system audits, inter-agency coordination, and adherence to existing laws and policies to achieve sustainable and transparent overload control across Tanzania's transport network.

Limitations and Areas for Further Studies

This New Institutional Theory (NIT)-based study had several drawbacks. It limited generalisation to other areas with different institutional and technological settings by concentrating on specific weighbridge stations in Morogoro. For national insights, true studies toneed use longer-term or more comprehensive designs. The regulative, normative, and cognitive pillars of NIT were not quantitatively tested; instead, the study focused on behavioural and institutional aspects (Scott, 1995). Hence, the need for future research to examine how these institutional components interact to affect weighbridge efficiency. Furthermore, institutional conformity for legitimacy rather than performance is suggested by persistent unethical behaviour and lax enforcement. Nevertheless, the study did not examine external factors like resource constraints or political influence. Therefore, future studies are needed to examine how these elements influence institutional procedures and the use of ICT. Finally, analysis was hampered by limited access to sensitive operational data, necessitating a research approach that combined institutional ethnography and policy methodologies.

Contribution of the Study to Knowledge and Theory

This study adds to the body of knowledge by demonstrating that institutional integrity, employee ethics, and enforcement mechanisms are just as important as technology in determining how well ICT controls vehicle overloading in Tanzania. By emphasising the interplay of organisational, behavioural, and technical factors, it broadens our understanding of performance gaps in public infrastructure management. The study demonstrates how the regulative, normative, and cognitive pillars affect weighbridge operations through the theoretical application of

New Institutional Theory (NIT). It provides empirical evidence supporting NIT and guiding future research on institutional behaviour, governance, and ICT implementation by demonstrating that technology adoption alone cannot guarantee compliance.

Authors' Contributions

Choka Kessy oversaw the conceptualisation and development of the research proposal, organised and carried out the fieldwork, oversaw data collection, carried out data analysis, and was primarily responsible for writing the manuscript titled. **Denis Kamugisha** supported field activity coordination, helped refine the proposal design, offered critical reviews and intellectual input on data interpretation, report writing, and final manuscript preparation, and provided methodological and theoretical guidance throughout the research process. Both authors agreed to take full responsibility for the work and approved the final draft of the manuscript.

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