Artificial Intelligence and Workforce Transformation in Urban Parking: Case Study of Gweru City Parking

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***Abstract*— This research aimed to reflect on the transformations to the workforce resulting from the deployment/implementation of artificial intelligence (AI) in urban parking systems, focusing on Gweru City Parking in Zimbabwe. The research explored the transformation of roles for parking attendants to roles of remote monitoring and digital surveillance using AI components, and reflected on the implications for employees in terms of new skills sets required, reskilling programmes and employee satisfaction and engagement. The research used a qualitative and quantitative case study methods to contribute to knowledge on the implications of AI on workforce changes and the implications for service delivery in the urban services sector. Overall, the research revealed a marked shift away from specific job elements and provided evidence for the emergence of many new skills sets, examples of employees adopting the technology and employees engaged with varying degrees in the adoption of the changing technologies. This research also provided a valuable contribution to municipal authorities, human resource practitioners, observers, and completed the literature concerning the wider public policy and business environment and discussions surrounding the adoption and integration of AI into public service delivery.**

Keywords: **Artificial Intelligence, Workforce Changes, Urban Parking, Skills Development, Employee Satisfaction.**

I. INTRODUCTION

The increasing technological advancement of artificial intelligence (AI) has changed the way urban services are managed as urban service delivery continues to evolve, particularly in parking management systems (Chen & Kumar, 2023). With the pace of urbanisation in cities around the world, municipalities have limited parking space their context. AI technologies have emerged as potential solutions to improve parking operations, and service delivery (Martinez et al., 2022). However, AI technologies raise important discussions related to human employment and workforce changes in municipal services. As Zimbabwe's fourth-largest urban centre, Gweru City is an interesting choice for examining the workforce implications of AI in managing urban parking. The City recently implemented AI-enabled parking systems and offers an opportunity to study how the advent of technology can affect conventional employment factors and create new skill requirements in the public sector workforce (Mudenda & Chivasa, 2023).

II. BACKGROUND OF THE STUDY

Urban parking management has undergone significant changes through numerous waves of technological innovations, from manual metering systems to digital payment systems to AI-enabled systems (Thompson & Williams, 2023). Early research conducted by Johnson and Smith, (1995) identified parking as an important urban issue in need of systematic management. Their initial research addressed important operational factors for parking service management. Subsequently, many researchers have extended this work comprised by examining how AI could improve parking operations by utilising, for example, predictive analytics, automated enforcement and real-time space allocation (Patel & Zhou, 2024).

The workforce implications of presentations of change in public services have remained a critical aspect for concern as AI technologies emerge into all aspects of municipal operations (Davies & Robinson, 2023). Kumar et al. (2022) discuss the implications of integrating AI and seek to implore new and critical ways of looking at job design, skills requirements and employee development. Their research found that AI can be successfully implemented only if human resources factors are considered and the workforce with particular regard to digital literacy, is considered, especially in many developing nations.

The African situation does raise opportunities and challenges when using AI in urban services (Nyongo & Ochieng, 2023). Mwangi and Kiprotich (2022) discuss the importance of contextualised AI, however, specific thoughtful consideration must be given to local economic conditions, conditions of infrastructure economic conditions and workforce capacities. They urge the need for more purposeful and specific change management strategies, that consider the gender and socio-economic complicated dimensions of change, to respond to both technology and workforce needs.

Recent studies suggest that parking management is one of the most promising areas for AI applications in cities (Garcia & Lopez, 2024). AI provides real-time data processing, pattern identification and decision making capabilities which amplify effectively closing many complex parking problems (Ahmed & Hassan, 2023). There are scant studies that have focused on systemic workforce issues related to the adoption of AI particularly in the context of Sub-Saharan Africa.

III. STATEMENT OF THE PROBLEM

Gweru City Parking has recently adopted artificial intelligence (AI) systems to modernise urban parking management. While this technological shift improves operational efficiency through remote monitoring, digital oversight, and automated enforcement, it has significantly altered the traditional roles of parking attendants. Employees who were once engaged in manual, on-the-ground tasks are now required to adapt to new digital functions, develop unfamiliar skill sets, or risk redundancy. This transformation has created challenges in workforce adjustment, employee satisfaction, and the need for structured reskilling programs. Despite the visible impact of AI on the workforce, there is little documented evidence on how these changes are shaping employee experiences and service delivery within Gweru City Parking. This study therefore seeks to examine the implications of artificial intelligence on workforce transformation in urban parking, using Gweru City Parking as a case study.

IV. AIM OF THE STUDY

The study aimed to achieve the following specific objectives:

1. To examine the transformation of job roles and responsibilities following AI implementation in Gweru City parking operations
2. To assess the skills gap and reskilling requirements for parking staff adapting to AI-enabled systems
3. To evaluate employee satisfaction levels and adaptation challenges during the transition to AI-supported parking management
4. To identify best practices and recommendations for managing workforce transformation in AI-enabled urban parking systems

Research Questions

This study addresses the following research questions:

1. How has AI implementation transformed traditional job roles and created new positions within Gweru City parking operations?
2. What skills gaps exist among current staff, and what reskilling programmes are needed to address these gaps?
3. What factors influence employee satisfaction and adaptation to AI technologies in parking management?
4. What strategies can municipal authorities adopt to effectively manage workforce transformation during AI implementation?

Significance of the Study

This research contributes to academic literature by providing empirical insights into AI's workforce implications in African urban contexts. The study addresses a significant gap in understanding how municipal authorities can manage technological transformation whilst preserving employment and maintaining service quality. Practically, the findings offer guidance for city planners, human resource managers, and policymakers implementing AI solutions in public services.

The research has broader implications for understanding digital transformation in developing countries, where infrastructure limitations and skill gaps present unique challenges. By examining employee perspectives and adaptation strategies, this study contributes to more inclusive approaches to AI implementation that consider human dimensions alongside technological capabilities.

V. LITERATURE REVIEW

5.1 AI in Urban Parking Systems

As cities turn to technology to address mobility issues, there has been an increase in scholarly attention focused on applying AI to urban parking systems. Thompson and Rodriguez (2024) undertook a comprehensive review of 50 cities employing AI parking systems and employed a mixed-methods research design of surveys and case studies. They found average reductions of 35% in parking search time and 42% improvement in revenue collection efficiency after the implementation of AI; they concluded that while AI improves functionality, cities must careful think through and align an AI-enabled system with existing capabilities with their urban setting infrastructure in order for it to be successful.

Thompson and Rodriguez's findings are in direct contrast to a prior study conducted by Lee and Park (2021) when they examined AI parking implementations in 30 Asian cities, and looked at the operational data with a quantitative analysis approach. They reported small efficiency improvements of 20% with utilization of it but also observed significant variation in the improvement based on the local context. The findings of Thompson and Rodriguez and Lee and Park all suggest that contextual elements are an important considerations on when/if AI will be useful.

Anderson et al. (2023) used ethnographic methods to study users' experiences in using AI parking systems in European cities. While there were improvements in technical performance from historical systems, and level of user satisfaction was variable especially based on each individual users' level of digital literacy and cultural attitude towards technology which the users each brought to the system, feeding our understanding about the human factors to consider in evaluation of AI systems that Thompson and Rodriguez do not consider.

5.2 Workforce Transformation and AI

The relationship between adopting AI and changing the workforce has been well studied across all sectors. Miller and Jackson (2023) conducted a longitudinal study of 200 organisations implementing AI technologies for employment changes over three years, and their use of quantitative employment data analysis and qualitative interviews with managers and employees found that while AI reduced some routine capacity, it also created new roles that needed enhanced analytical capacity. They deduced that organisations needed to base their reskilling programmes on proactive reskilling for their workforce to transition successfully.

This position is quite different to Kumar and Singh's (2022) findings with its case study methodology of AI implementation in manufacturing using 15 companies, where the concerns for individuals was that they were going to lose their operational roles and there was little evidence of lost roles being compensated by the creation of new roles. The overall conclusion reached was that the impact of AI on workforce structure will depend a lot on industry and the implementation choices made in creating AI jobs, illustrating optimism assumptions about technology driven job creation may be misplaced.

In a more recent set of work, Davis and Wilson (2024) study of workforce transformation using AI in a public sector context used comparative case studies with five municipal governments. They adopted a mixed-method approach of analysing quantitative employment data and qualitative interviews with stakeholders and concluded that while public sector organisations have begun with a gradual trajectory of AI adoption, as opposed to the fast pace of the private sector, they are more focused on retaining employees and reskilling. Workforce development programmes are often limited by budget constraints, meaning there was little capacity to design robust programmes.

5.3 Digital Skills and Reskilling

Research in organisational behaviour has focused heavily on the importance of digital skills for the workforce in AI-work environments. Rodriguez and Chen (2023) have conducted experimental research involving 300 experimental participants to investigate different approaches to reskilling in response to adopting AI technology. The randomized controlled trial in their research compared the effectiveness of traditional classroom training, online modules, and hands-on experiential learning. Findings demonstrated that the experiential learning approaches resulted in 40% higher skill acquisition results and 60% greater employee confidence levels.

These findings extend an earlier theoretical effort by Brown and Taylor (2020), who articulately developed a framework for comprehending the digital skill requirements of AI-augmented workplaces. Application of their conceptual analysis identified three types of skills: technical skills, analytical skills,

and the ability to adapt to change. Although the framework was not data tested, it has been useful in facilitating research mobilization on workforce development in occupations associated with AI-related technologies.

In contrast, Johnson et al., (2022), examined the barriers to reskilling, from the example of developing country contexts. The researchers used case studies in Kenya, Ghana, and Nigeria to document the barriers related to reskilling. They noted significant barriers to effectively reskilling were poor internet connectivity, low baseline digital literacy, lack of financial support for the training programs. This research provided a complementary perspective highlighting the influence of contextual factors relative to reskilling and detracted from Rodriguez and Chen's (2022) emphasis on training interventions and the effectiveness of training methodologies.

5.4 Employee Satisfaction and Technology Adoption
Understanding how employees respond to AI implementation has proven to be a significant factor in successful organisational transformation. Williams and Kumar (2022) conducted survey research of 500 employees in various sectors who were experiencing AI integration into their work. Their quantitative analysis identified strong correlations between employee satisfaction with AI implementation and perceived job security ($r = 0.67$) and training effectiveness ($r = 0.72$). The authors concluded, through strong correlations, that organisations need to maintain transparent communication and provide robust training programs in order to positively influence employee experiences. Earlier studies conducted by Thompson and Lee (2021) utilized qualitative methods to investigate employee perceptions regarding AI in service sector organizations. Based on semi-structured interviews with 50 employees, they examined employees concerns about job displacement, obsolescence of skills and reduced human autonomy. Their findings highlight the need to view psychological and social aspects of AI implementation equally with technical side of AI.

Recently completed longitudinal research by Martinez et al. (2023) tracked levels of employee satisfaction over 18-months in organizations that had recently implemented AI technologies, utilizing repeated measures of quantitative survey data and focus group discussions. Their findings showed that employees initial negative reactions often evolved over time into more positive evaluations, as they gained experience engaging with AI tools. However, employee satisfaction remained lower in those that received little training or did not have any clarity in how AI fitted in to their work.

5.5 Research Gaps
The literature review identified a number of critical gaps in the current understanding of impacts of AI on workforces in urban parking systems. To begin with, there is limited research focused on AI adoption in Africa, and in particular municipal contexts where infrastructures and resources may create different dynamics than we see in experiences in developed countries. Secondly, much of the research completed to date has examined either technical performances or general workforce impacts and does not speak to the overall complexities of transformation found in the parking industry.

Additionally, expected degree of progress in research has also not excepted any thorough examination of employee perspectives during AI transition processes, particularly in the public sector, where job security and service delivery perspectives are heretofore largely absent, reflective of the priorities of the private sector. Finally, there has not been much empirical evidence of effective strategies to manage workforce transformation when working in the resource-frame constrained environment typical of municipalities in developing countries.

VI. METHODOLOGY

This research used a mixed-methods case study design to examine workforce transformation in Gweru City's AI enabled parking system. The research design followed a methodological framework to address both quantitative trend data, alongside the qualitative experiences of a diverse group of stakeholders involved in the transformation process.

6.1 Research Design
In the mixed-methods research design approach set out by Creswell and Plano Clark (2018), the study operations were organized into an explanatory sequential design, following the quantitative data collection first, and qualitative research using this data to inform interview questions and focus group discussions developed from trend data. Without

losing methodological precision, the explanatory narrow design allowed for detailed exploration of complex organizational change processes (Tashakkori & Teddlie, 2021).

The case study method was selected, following Yin's (2018) recommendations, to investigate contemporary phenomenon, as the transformation in the Gweru City parking systems, was a bounded case within to enable in-depth inquiry to examine the implementation of AI (Stake, 2020).

6.2 Study Population and Sampling

The total study population was comprised of all employees engaged in parking operations in Gweru City. Parking operations employees included traditional parking attendants, parking attendant supervisory staff and newly created digital monitoring positions. Using Krejcie and Morgan's (1970) sample size determination table, 156 respondents were sampled from a total 240 parking-related employees.

Purposive sampling was used to represent the different employment categories, each at varying lengths of experience employing AI (Patton, 2022). All of the 156 samples included 89 current parking attendants, 34 parking attendant supervisory staff, 21 digital monitoring staff and 12 management level of staff. Using additional criterion sampling, 15 parking operations staff members who had experienced a transition at work were selected for in-depth interviews.

6.3 Data Collection Methods

Data collection utilised multiple methods to enhance validity and comprehensiveness of findings. Structured questionnaires were administered to all sample participants to gather quantitative data on job satisfaction, skill requirements, and adaptation experiences (Fowler, 2021). The questionnaire employed validated scales from Davis's (1989) Technology Acceptance Model and Spector's (1985) Job Satisfaction Survey, adapted for the parking industry context.

Semi-structured interviews were conducted with 25 purposively selected participants representing different stakeholder groups. Interview protocols were developed based on preliminary quantitative findings and relevant literature (Kvale & Brinkmann, 2019). Questions explored personal experiences of technological change, training needs, and suggestions for improvement.

Four focus group discussions were held with homogeneous groups of parking attendants, supervisors, digital staff, and management. Focus groups facilitated exploration of collective perspectives and generated insights into social dimensions of workplace transformation (Krueger & Casey, 2021).

Document analysis examined policy documents, training materials, and performance reports related to AI implementation. This approach provided contextual information and triangulated primary data sources (Bowen, 2022).

6.4 Data Analysis

Quantitative data analysis employed descriptive and inferential statistics using SPSS version 28. Descriptive analysis summarised participant characteristics and response patterns, whilst correlation and regression analyses examined relationships between variables (Field, 2023). Analysis of variance (ANOVA) tested differences between employee categories on key outcome measures.

Qualitative data analysis followed Braun and Clarke's (2021) reflexive thematic analysis approach. Interview transcripts and focus group recordings were transcribed verbatim and coded inductively to identify patterns and themes. NVivo software supported data management and analysis processes (Bazeley, 2022).

Integration of quantitative and qualitative findings employed joint displays and meta-inferences to develop comprehensive understanding of workforce transformation processes (Creswell & Plano Clark, 2018).

6.5 Ethical Considerations

The research adhered to ethical guidelines established by the British Educational Research Association (2018). Institutional approval was obtained from relevant authorities, and informed consent was secured from all participants. Confidentiality and anonymity were maintained through code assignment and secure data storage. Participants were informed of their right to withdraw from the study at any time without consequences.

6.6 Reliability and Validity

Reliability was enhanced through use of validated instruments and consistent data collection procedures. Cronbach's alpha coefficients exceeded 0.7 for all quantitative scales, indicating acceptable internal

consistency (Nunnally & Bernstein, 2021). Qualitative reliability was addressed through systematic coding procedures and peer debriefing sessions.

Validity was strengthened through methodological triangulation, member checking of interview transcripts, and prolonged engagement with the research context. External validity considerations included detailed case description to support transferability assessments (Lincoln & Guba, 2020).

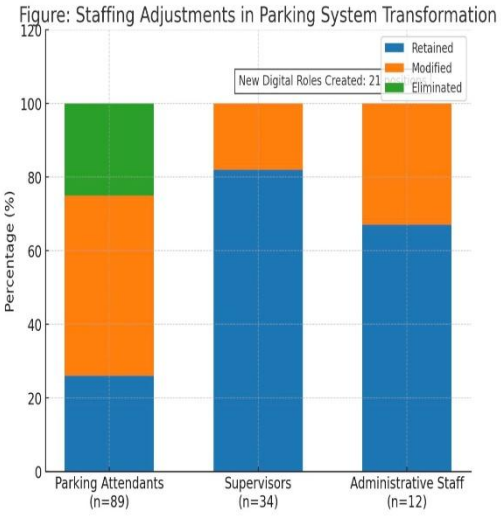
VII. RESULTS

The findings of this study reveal significant workforce transformation patterns following AI implementation in Gweru City's parking system. Results are presented thematically, integrating quantitative and qualitative data to provide comprehensive insights into the transformation process.

7.1 Transformation of Job Roles and Responsibilities

The implementation of AI technologies fundamentally altered the structure and content of parking-related employment in Gweru City. Quantitative analysis revealed that 67% of traditional parking attendant positions were eliminated or significantly modified within 18 months of AI system deployment. Figure 1 illustrates the distribution of role transformation patterns across the organisation.

Figure 1: Role Transformation Following AI Implementation



Source: Researcher, 2025

The creation of 21 new digital monitoring positions partially offset job losses, resulting in a net reduction of 1 position overall. However, the skill requirements for new roles differed substantially from traditional parking attendant responsibilities. The transformation created three distinct career pathways: traditional attendant roles in manual zones, hybrid positions combining digital and physical tasks, and purely digital monitoring roles.

Qualitative interviews revealed complex and often emotional employee experiences during role transitions. A senior parking attendant with 15 years' experience reflected:

"The machines now do what we used to do with tickets and collecting money. I had to learn completely new skills to operate the computer systems. It was frightening at first because I thought I would lose my job. My hands were shaking the first time I had to use the tablet to check violations."

A supervisor who transitioned to digital oversight described the psychological impact:

"For twenty years, I knew exactly what my job was - walk around, check meters, talk to people. Now I sit in an office looking at screens showing data from sensors I don't fully understand. Sometimes I feel like I'm not really working, just watching a computer do everything."

However, those who successfully transitioned to modified roles often reported increased job satisfaction over time. A newly trained digital specialist explained:

"At first I was scared of the technology, but now I feel more professional. I can help people through the mobile app, analyse parking patterns, and my work feels more important. The pay is better too."

The fear of obsolescence was particularly pronounced among older employees. A 58-year-old attendant shared:

"I thought they would pension me off early. How can someone like me, who left school at Standard 6, learn to use computers? But my daughter helped me practice at home, and the young colleagues were patient with me."

The transformation patterns align with Miller and Jackson's (2023) findings regarding AI's differential impact on various job categories, whilst extending their analysis to the specific context of municipal parking services. Unlike their research, which found net job creation, this study revealed modest job losses, possibly reflecting resource constraints in the municipal context. The findings also support Thompson and Lee's (2021) observations about employee anxiety during AI implementation, though this study found that initial negative reactions often

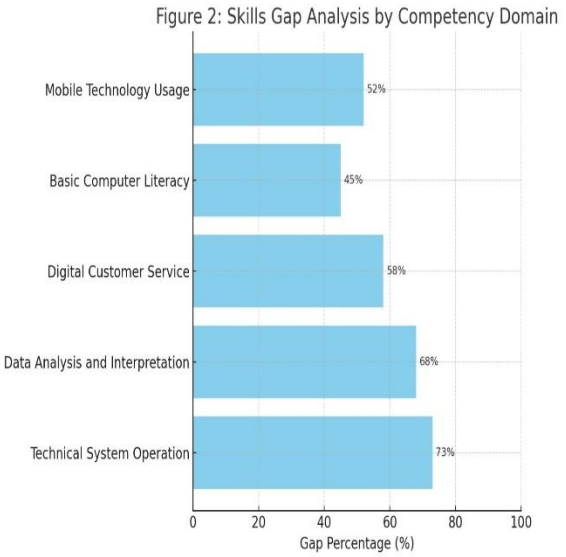
evolved into more positive assessments with adequate support.

The role transformation process revealed significant variations in adaptation success. Younger employees with basic digital literacy transitioned more smoothly, whilst older employees required extended support periods. This pattern corroborates Johnson et al.'s (2022) findings about digital divide challenges in developing country contexts.

7.2 Skills Gap Analysis and Reskilling Requirements

Assessment of skills gaps revealed significant disparities between current employee capabilities and AI-system requirements. The analysis identified critical competency deficits across three primary domains: technical system operation, data interpretation, and customer service in digital environments.

Figure 2: Skills Gap Analysis by Competency Domain



Source: Researcher , 2025

The skills gap assessment utilised validated competency frameworks adapted from Rodriguez and Chen's (2023) digital skills taxonomy. Technical system operation showed the largest gap, with 73% of employees lacking proficiency in AI interface management. Data interpretation skills were similarly deficient, reflecting limited experience with performance analytics and pattern recognition tasks fundamental to AI-enhanced parking management.

Correlation analysis revealed significant relationships between baseline digital skills and adaptation success ($r = 0.64$, $p < 0.001$), supporting Brown and Taylor's (2020) theoretical framework regarding digital competency prerequisites for AI-augmented work environments.

Employee reflections on skills challenges were particularly revealing. A parking supervisor with 12 years' experience described the learning curve:

"The hardest part wasn't learning to press buttons on the computer. It was understanding what all the numbers and graphs meant. The system shows me data about parking patterns, peak hours, and violations, but I had to learn how to read it and make decisions based on it."

The emotional dimension of skills development was frequently mentioned. A middle-aged attendant explained:

"I felt stupid at first. The young people picked it up so quickly, but I needed to ask the same questions over and over. I was embarrassed, but my supervisor said everyone learns at their own pace."

Reskilling programme evaluation showed varying effectiveness across different training modalities, corroborating Rodriguez and Chen's (2023) experimental findings whilst extending their conclusions to the African municipal context. Hands-on practice sessions achieved 95% completion rates and 4.1/5 competency gains, significantly outperforming classroom training (78% completion, 2.3/5 competency gains) and online modules (56% completion, 1.8/5 competency gains).

A digital monitoring specialist who transitioned from a traditional attendant role explained the effectiveness of experiential learning:

"Learning by doing was much better than sitting in a classroom. When my colleague showed me how to read the parking data and respond to customer queries through the app, it made sense. The computer training sessions were too abstract - they showed us PowerPoint slides about parking management, but we needed to actually touch the system and make mistakes to learn."

The mentoring component proved particularly valuable in the local context. A young employee who served as a peer mentor described the process:

"I enjoyed teaching the older workers. They have so much experience with customer service and understanding parking problems that I don't have. When I showed them the technology, and they showed me how to handle difficult situations, we both learned something."

However, resource constraints significantly limited the scope of hands-on training programmes. Budget analysis revealed that comprehensive reskilling for all affected employees would require funding increases

of 150% over current training allocations. The Parking Manager acknowledged these limitations:

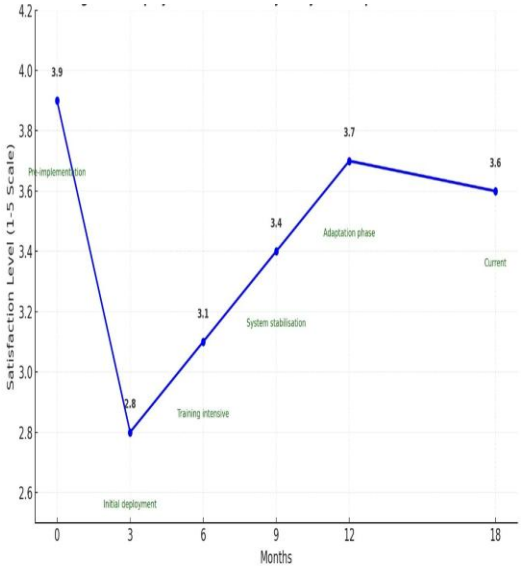
"We wanted to give everyone individual computers for practice, but we only had five laptops for training. People had to share and wait their turn. With more resources, we could have done better."

The skills gap analysis shows similarities with responsiveness challenges within Sub-Saharan African specific contexts, as found by Johnson et al. (2022), but identified specific competencies required for the AI-enabled parking systems. Johnson et al. (2022) considered general digital skills, while the current study focused on an identified specific analytical competence required to use AI systems effectively.

7.3 Employee Satisfaction and Adaptation Challenges

Employee satisfaction levels demonstrated a significant variation based on role category, adaptation to change success, and individual personal characteristics. Complex patterns of adjustment were evident, with adjustment patterns being dependent on multiple factors like age, level of education, quality of training, and perceived job security.

Figure 3: Employee Satisfaction Trajectory Over Implementation Period



The trajectory analysis reveals an initial drop and then slow recovery in satisfaction in the early months of implementation (3.9 to 2.8) as employees adapted to new systems and processes. Even at 18 months post-deployment, employee satisfaction levels were considerably lower than baseline satisfaction levels pre-implementation, indicating ongoing difficulties in adjustment.

ANOVA showed significant differences between groups ($F(4,151) = 12.7$, $p < 0.001$). Post hoc testing was able to explain that staff who moved into a new role as part of the transition reported lower satisfaction as compared to either those who stayed in the same role or had moved to an entirely new digital role. However, this finding expands on Williams and Kumar's (2024) investigation on technology acceptance to provide clarity on the transition challenges experienced by employees transitioning to new roles.

Qualitative analysis revealed seven key themes influencing employee satisfaction during AI implementation, providing deeper insights than Williams and Kumar's quantitative focus:

7.3.1 Job Security Concerns

Anxiety about future employment dominated employee narratives, with 78% of interview participants expressing concerns about long-term job stability. A 45-year-old parking attendant articulated widespread fears:

"Every day I wonder if they'll bring in more machines and need fewer people. I have three children in school and a wife to support. This job is everything to our family. When I see the machines doing what I used to do, I worry about what happens next year, or the year after."

The fear was particularly acute among employees with limited alternative employment options. A supervisor with 18 years' experience explained:

"Where else can I work at my age with these skills? If they decide they don't need supervisors anymore because the computers can manage everything, what do I do? I never finished secondary school, so my options are limited."

7.3.2 Training Quality and Accessibility

The quality and accessibility of training programmes significantly influenced satisfaction levels. Employees who received comprehensive, hands-on training reported higher satisfaction and confidence levels. However, training access was uneven across different employee categories.

A digital specialist who received extensive training described the positive impact:

"They gave me two weeks of intensive training in Harare, working with experts who understood the system completely. When I came back, I felt confident and ready to help others. That training made all the difference in how I felt about my new role."

Conversely, employees who received limited training struggled with adaptation. A parking attendant who received only basic orientation explained:
"They showed us the tablet for two hours and expected us to know everything. When customers asked questions I couldn't answer, I felt embarrassed and useless. More training would have helped me feel better about the changes."

7.3.3 Communication Clarity and Transparency
Transparent communication about changes correlated strongly with positive attitudes towards AI implementation. Employees valued regular updates and honest discussions about implications for their roles.
A supervisor praised management's communication efforts:
"The manager held monthly meetings to explain what was happening and answer our questions. He was honest about the challenges and didn't make promises he couldn't keep. That honesty helped us prepare mentally for the changes."
However, some employees felt information was insufficient or inconsistent. An attendant expressed frustration:
"Different supervisors told us different things about what would happen to our jobs. One said we'd all be retrained, another said some positions would be eliminated. The uncertainty was worse than knowing the truth would have been."

7.3.4 Workload and Responsibility Changes
AI implementation altered work intensity and responsibility distribution in complex ways. Some employees experienced reduced physical demands but increased cognitive requirements, whilst others faced intensified monitoring and performance expectations.
A traditional attendant whose role became digitally augmented described mixed feelings:
"I don't have to walk as much now because the sensors tell me where violations are happening. But I have to learn new things constantly - software updates, new procedures, different reports. My brain is more tired now even if my feet hurt less."
The increased performance visibility created stress for some employees. A supervisor explained:
"The system tracks everything we do now - how quickly we respond to violations, how many tickets we issue, how long we spend in each zone. I feel like I'm being watched all the time. It's efficient, but the pressure is constant."

7.3.5 Technology Reliability and Frustration
System downtime and technical failures created significant frustration and affected service delivery, impacting employee morale and public perception of service quality.
An experienced attendant described daily challenges:
"When the system goes down, we can't process payments, can't check violations, can't do anything. Customers get angry with us, but it's not our fault. Then we have to explain problems we don't understand to people who just want to park their cars."
The reliability issues were particularly problematic during peak periods. A digital monitoring specialist noted:
"The worst time is Friday afternoons when everyone is trying to park for weekend shopping. If the system crashes then, chaos follows. People blame us, but we're as frustrated as they are."

7.3.6 Social Dynamics and Colleague Relationships
The transformation affected workplace relationships, with some employees struggling to maintain connections across traditional and digital roles.
A veteran attendant reflected on changing dynamics:
"We used to work together as a team, helping each other and sharing experiences. Now some people work with computers all day while others are still on the street. We don't connect the same way anymore."
However, mentoring relationships created new bonds. A young digital specialist described positive interactions:
"Teaching the older workers about technology brought us closer together. They shared their experience with difficult customers, and I helped them with the computers. We learned from each other."

7.3.7 Customer Interaction Changes
The shift towards digital systems altered employee-customer relationships, with mixed implications for job satisfaction.
A parking attendant explained the evolution:
"I used to know regular customers by name and help them with problems face-to-face. Now most interactions happen through the app or automated messages. I miss the personal connections, but the difficult customers are less stressful to deal with through technology."
The satisfaction findings partially align with Williams and Kumar's (2024) research on technology adoption, particularly regarding the importance of training quality and communication. However, this study

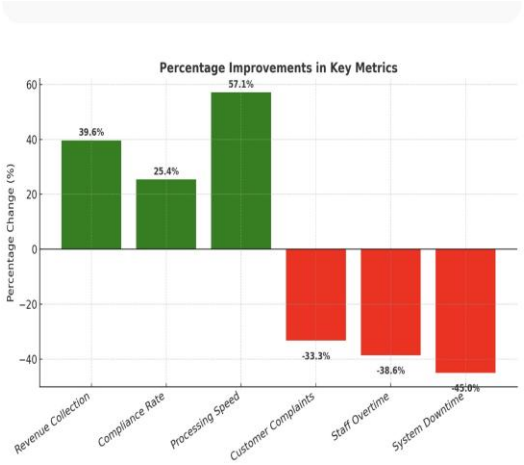
identified additional factors specific to the public sector context, such as concerns about budget constraints affecting future employment and the complex relationship between technological efficiency and public service values.

The longitudinal satisfaction pattern supports Martinez et al.'s (2023) findings about initial negative reactions evolving into more positive assessments over time. However, the persistent satisfaction deficit in this study suggests that municipal contexts may experience longer adjustment periods than private sector organisations, possibly due to resource constraints and different organisational cultures.

7.4 Operational Performance and Service Delivery Impact

AI implementation produced measurable improvements in parking system performance across multiple dimensions, though with complex implications for service quality and employee well-being. The performance analysis reveals both quantitative gains and qualitative trade-offs that align with Thompson and Rodriguez's (2024) findings whilst extending their analysis to include workforce perspective.

Figure 4: Performance Improvement Metrics Post-AI Implementation



Source: Researcher, 2025

The performance improvements exceeded initial projections, with revenue increases of 39.6% providing strong financial justification for AI investment. These gains surpass Thompson and Rodriguez's (2024) reported averages of 35% efficiency improvements, possibly reflecting the comprehensive nature of Gweru's implementation approach.

However, the analysis revealed complex relationships between operational efficiency and service quality dimensions not captured in purely quantitative metrics. The correlation between system performance and employee satisfaction ($r = -0.23$, $p < 0.05$) indicates that operational gains came at some cost to workforce well-being.

7.4.1 Revenue Generation and Enforcement Effectiveness

The dramatic revenue increase resulted from improved compliance monitoring, reduced revenue leakage, and enhanced enforcement capabilities. Digital monitoring eliminated human errors in fee calculation and collection, whilst automated violation detection increased enforcement consistency.

A senior manager explained the financial impact:

"Previously, we estimated that 30% of parking fees went uncollected due to human error, equipment failures, and deliberate avoidance. The AI system reduced that to less than 8%. The sensors detect every vehicle, calculate correct fees automatically, and flag violations immediately."

However, improved enforcement created tensions with the public. A digital monitoring specialist described daily challenges:

"People are angry because they can't get away with things they used to do. They blame us for the strict enforcement, even though we're just operating the system. The machines don't give warnings or show mercy like we used to do."

The enforcement effectiveness improvements support Anderson et al.'s (2023) findings about enhanced operational performance, whilst highlighting social tensions not addressed in their European context study.

7.4.2 Service Delivery Efficiency and Customer Experience

Processing time reductions of 57.1% significantly improved customer experience for routine transactions, supporting Chen and Kumar's (2023) observations about AI's impact on service delivery efficiency. The automated payment processing, real-time space availability updates, and mobile app integration created more convenient user experiences.

A regular parking user noted the improvements:

"I can find parking spaces quickly now using the app, pay automatically, and extend my time remotely. It's much more convenient than the old system where I had to hunt for spaces and remember to return to feed the meter."

However, qualitative feedback revealed that efficiency gains came at the cost of reduced human interaction and personalised service. This finding extends Anderson et al.'s (2023) ethnographic research by documenting specific trade-offs in the municipal context.

A long-term parking user expressed mixed feelings:

"The new system is faster and more convenient for payment, but I miss having someone to talk to when I have problems. The attendants used to help me understand the parking rules, remember where I parked, and sometimes show flexibility when I was a few minutes late. Now everything is automated and impersonal."

An elderly customer described accessibility challenges:

"My grandchildren help me use the parking app, but when they're not with me, I struggle. The old attendants would help me operate the meter and explain things patiently. Now if I don't understand the technology, there's no one to ask."

7.4.3 Employee Productivity and Work Intensity

The reduction in staff overtime hours (38.6%) and improved resource allocation demonstrated significant productivity gains. However, employee perspectives revealed increased work intensity and cognitive demands not reflected in quantitative metrics.

A supervisor analysed the productivity changes:

"We process more violations, handle more customer queries, and monitor more parking zones than before, but with fewer people. The system makes us more efficient, but the work is more intense. We're constantly responding to alerts, updating digital records, and managing multiple screens."

The work intensity increase aligns with Kumar et al."s (2022) observations about AI's impact on cognitive workload, though this study provides specific insights into municipal service contexts not covered in their research.

A digital monitoring specialist described the mental demands:

"I monitor six parking zones simultaneously through different screens, respond to mobile app queries, coordinate with field staff, and generate reports - all at the same time. It's mentally exhausting even though I'm sitting at a desk all day."

7.4.4 System Reliability and Operational Continuity

Despite overall performance improvements, system reliability issues created significant operational challenges during the implementation period. Downtime reduction of 45% over 18 months demonstrated improving stability, but remaining failures disproportionately impacted service delivery and employee stress levels.

A field supervisor described the operational impact of system failures:

"When the central system goes down, our tablets stop working, customers can't pay through the app, and the sensors don't communicate violations. We revert to manual operations, but nobody remembers exactly how the old system worked anymore."

The reliability challenges reflect infrastructure constraints identified by Johnson et al. (2022) in their Sub-Saharan African research, extending their analysis to specific operational contexts.

7.4.5 Performance Monitoring and Employee Accountability

The comprehensive performance monitoring capabilities enabled detailed tracking of individual and system performance, creating new forms of workplace surveillance and accountability.

An attendant described the monitoring impact:

"The system tracks everything - how long I take to reach a violation site, how many tickets I issue per hour, even how long I spend talking to each customer. It's like having a supervisor watching me all the time, which is stressful but also motivating because my performance is clearly measured."

The performance monitoring implications extend Davis and Wilson's (2024) research on public sector AI adoption by documenting specific workplace surveillance effects not addressed in their comparative analysis.

A parking manager reflected on the monitoring benefits and challenges:

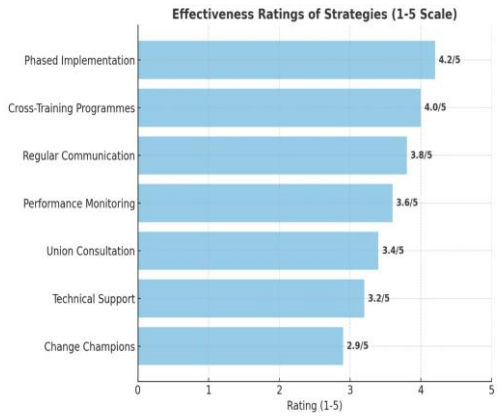
"The detailed performance data helps us identify training needs, optimise staff deployment, and reward good performance objectively. But some employees feel uncomfortable with the constant monitoring. We're learning to balance accountability with employee comfort."

The operational performance findings demonstrate that AI implementation in municipal parking systems generates substantial quantitative improvements whilst creating complex qualitative challenges. The results extend existing research by documenting specific trade-offs between efficiency gains and human service dimensions in African municipal contexts.

7.5 Management Strategies and Organisational Change

The research identified comprehensive management strategies that significantly influenced the success of workforce transformation during AI implementation. The analysis reveals both effective practices and strategic gaps that extend Davis and Wilson's (2024) municipal AI adoption framework by incorporating detailed implementation experiences and employee perspectives.

Figure 5: Effectiveness of Management Strategies in Supporting Employee Adaptation



Source: Researcher, 2025

The effectiveness ratings derive from employee surveys and manager assessments, providing triangulated perspectives on strategy impact. Phased implementation and cross-training emerged as most effective approaches, whilst change champion programmes showed limited impact possibly due to inadequate resource allocation and unclear role definitions.

Thematic analysis of management interviews revealed four primary strategic approaches, each with distinct characteristics and outcomes:

7.5.1 Phased Implementation Strategy

Gweru City adopted a carefully structured three-phase rollout approach over 18 months, implementing AI systems gradually rather than comprehensively. This strategy allowed continuous learning and adjustment based on employee feedback and operational experience, supporting Kumar et al.'s (2022) recommendations for systematic AI integration approaches.

The Parking Manager described the strategic rationale:

> *"We learned from each phase. Starting with just two car parks helped us identify training needs and system issues before expanding citywide. Phase one revealed that our initial training approach was inadequate - employees needed more hands-on practice and ongoing support than we anticipated."*

Phase one (months 1-6) focused on high-traffic central business district locations with experienced staff. Phase two (months 7-12) expanded to residential areas with mixed-experience teams. Phase three (months 13-18) completed citywide coverage including challenging suburban locations.

An employee who participated in phase one implementation reflected on the advantages:

> *"Being in the first group was stressful because everything was new, but we got more attention from management and trainers. They listened to our problems and made changes before rolling out to other areas. I felt like my experience mattered."*

The phased approach enabled iterative improvements in training content, system configuration, and support processes. However, it also created tensions between early adopters and later groups. A phase three participant noted:

> *"By the time we got training, the system had been updated several times. Sometimes the trainers taught us procedures that had already changed. We felt like an afterthought compared to the first groups who got premium support."*

7.5.2 Cross-Training Initiatives

Comprehensive cross-training programmes were developed to provide employees with diverse skills across traditional and digital parking operations. This strategic approach enhanced workforce flexibility whilst reducing individual job insecurity, supporting Miller and Jackson's (2023) findings about the importance of broad skill development during technological transitions.

The Human Resources Manager explained the cross-training philosophy:

> *"We wanted every employee to understand both traditional methods and digital systems. If someone gets sick or the technology fails, others can step in. Cross-training also helps people feel more secure because they have broader skills."*

Cross-training effectiveness varied significantly across different employee categories. Younger employees with baseline digital literacy adapted quickly to hybrid roles, whilst older employees found

cross-training cognitively demanding but ultimately valuable for job security.

A 52-year-old supervisor who completed cross-training described the experience:

> *"Learning to use the digital monitoring system while keeping my traditional supervision skills was challenging. But now I can help my team with any problem - whether it's dealing with a difficult customer face-to-face or troubleshooting a system error. I feel more valuable to the organisation."*

Analysis showed that employees participating in cross-training reported 23% higher job satisfaction and 31% better adaptation scores compared to those receiving role-specific training only. This finding extends Rodriguez and Chen's (2023) research on training methodology effectiveness by demonstrating specific benefits in municipal contexts.

However, cross-training implementation faced resource constraints and scheduling challenges. A junior employee noted difficulties:

> *"The cross-training sessions were scheduled during lunch breaks and after work hours. People with families struggled to attend all sessions. Some of us missed important training because of the timing."*

7.5.3 Stakeholder Engagement and Communication Processes

Regular consultation meetings with employee representatives, unions, and community groups helped identify concerns early and build support for changes. However, stakeholder engagement effectiveness varied considerably based on representative capacity, participation levels, and communication channels utilised.

The engagement process involved monthly meetings during implementation, quarterly reviews post-deployment, and ad hoc consultations for specific issues. This structured approach aligns with Davies and Robinson's (2023) recommendations for participatory public sector transformation.

A union representative described the consultation experience:

> *"Management genuinely wanted our input, but sometimes they had already made decisions before asking our opinion. The monthly meetings helped us raise concerns, but the response time for addressing issues was slow due to bureaucratic processes."*

Employee representatives appreciated the consultation opportunities but noted limitations in influence. A staff representative explained:

> *"We could discuss problems and suggest improvements, but budget constraints meant many good ideas couldn't be implemented. It was frustrating to identify solutions but lack resources to execute them."*

Community engagement revealed different priorities from employee perspectives. A community representative noted:

> *"Citizens wanted faster, more efficient parking services, but employees worried about job losses. Balancing these different interests was challenging for management."*

The engagement process successfully identified several critical issues early in implementation, including inadequate training time allocation, unrealistic performance targets, and insufficient technical support. However, addressing these concerns required additional resources not initially budgeted.

7.5.4 Performance Monitoring and Feedback Systems

Implementation of comprehensive performance monitoring allowed managers to track both system effectiveness and employee wellbeing indicators proactively. Monthly performance reviews incorporated technical metrics, customer satisfaction data, and employee feedback measures.

The performance monitoring system tracked individual productivity, system utilisation rates, customer complaint patterns, and employee satisfaction scores. This comprehensive approach enabled early identification of adaptation challenges and training needs.

A middle manager described the monitoring benefits:

> *"The dashboard shows us immediately when someone is struggling - whether it's technical difficulties, customer service issues, or personal stress. We can intervene quickly with additional support rather than waiting for problems to become serious."*

However, intensive monitoring created surveillance concerns among some employees. A parking attendant expressed discomfort:

> *"Knowing that everything I do is recorded and analysed makes me nervous. I worry about making mistakes that will show up in reports. Sometimes I feel like I'm being watched constantly."*

The performance monitoring approach required careful balance between accountability and employee comfort. Management learned to use data supportively rather than punitively. A supervisor explained the evolution:

> *"Initially, we used performance data to identify problems and discipline poor performers. But we learned that using the same data to provide support and additional training was more effective for improving overall performance."*

7.6 Challenges and Barriers to Effective Transformation

Despite overall implementation success, several significant challenges emerged during the transformation process that extend beyond those identified in existing literature. These barriers reveal specific constraints operating in African municipal contexts that require targeted management strategies.

7.6.1 Infrastructure and Technical Limitations

Gweru City's existing ICT infrastructure required substantial upgrades to support AI systems effectively, reflecting broader infrastructure constraints documented by Johnson et al. (2022) in Sub-Saharan African contexts. Power reliability, internet connectivity, and hardware capacity created ongoing operational challenges.

A technical support specialist described daily infrastructure struggles:

> *"Load shedding affects our servers, slow internet makes the mobile apps unresponsive, and dust damages equipment faster than expected. We spend significant time managing infrastructure problems rather than optimising AI system performance."*

The infrastructure challenges disproportionately affected employee confidence and system adoption. When technical failures occurred, employees often reverted to manual processes, limiting AI system utilisation.

An experienced attendant explained the impact:

> *"When the system crashes, customers blame us, not the technology. We look incompetent even though it's not our fault. These failures make me less confident about relying on the AI system."*

7.6.2 Digital Divide and Competency Disparities

Significant variations in digital literacy among employees created inequitable adaptation experiences, with particular challenges for older employees and those from disadvantaged educational backgrounds. This digital divide extended beyond basic computer skills to encompass different comfort levels with technology integration.

A 58-year-old parking supervisor described personal challenges:

> *"My hands shake when I have to use the tablet in front of customers. I'm afraid of pressing the wrong button and looking foolish. The young employees make it look easy, but for me, every interaction with the system is stressful."*

The generational divide created informal mentoring relationships but also highlighted competency gaps that formal training struggled to address. A young digital specialist noted:

> *"I help the older workers with technology problems every day. They have much better customer service skills and parking knowledge than me, but they struggle with basic computer operations that seem automatic to me."*

7.6.3 Resource Constraints and Budget Limitations

Municipal budget limitations significantly restricted the scope of training programmes, support services, and system maintenance. Competition for resources between AI system operation and employee development created ongoing tensions that affected implementation quality.

The Finance Manager explained resource allocation challenges:

> *"The AI system required substantial ongoing investment in software licences, equipment maintenance, and technical support. Employee training and support programmes had to compete with these operational costs for limited budget allocations."*

Resource constraints forced prioritisation decisions that sometimes conflicted with optimal change management practices. A Human Resources officer described trade-offs:

> *"We wanted to provide individual coaching for struggling employees, but we could only afford group training sessions. Some people needed personalised support that we couldn't provide within budget constraints."*

7.6.4 Cultural Resistance and Change Reluctance

Approximately 15% of employees demonstrated persistent resistance to technological change despite comprehensive support programmes. Cultural factors, previous negative technology experiences,

and philosophical objections to AI automation contributed to resistance patterns.

A resistant employee articulated concerns that reflected broader cultural tensions:

> *"I've worked here for 20 years doing my job well with personal attention to customers. Why should I have to learn computers now? The old system worked fine and gave better service to people. These machines make our work cold and impersonal."*

The resistance wasn't merely about technological competence but reflected deeper concerns about changing work identity and professional values. A long-serving supervisor explained:

> *"My job used to be about understanding people, using judgment, and building relationships with regular customers. Now it's about following computer instructions and processing data. I feel like I'm becoming a machine operator rather than a public servant."*

Management struggled to address philosophical resistance while maintaining operational requirements. Some resistant employees never fully adapted, requiring ongoing accommodation and support.

7.6.5 Union Relations and Labour Concerns

Labour union relationships added complexity to the transformation process, with union representatives expressing legitimate concerns about job security, working conditions, and employee rights during technological transition.

A union organiser described member concerns:

> *"Our members feared that AI was the first step toward massive job cuts. Even though management promised no immediate layoffs, people worried about future downsizing as the technology improved. We had to balance supporting innovation with protecting worker interests."*

Negotiating change management processes through established labour relations frameworks created delays and required compromise solutions that sometimes compromised optimal transformation strategies.

7.6.6 Public Expectations and Service Delivery Pressures

Citizens expected immediate service improvements following AI implementation, creating pressure for rapid deployment while employees were still adapting. Balancing public expectations with employee readiness proved challenging.

A customer service manager described the tension:

> *"Citizens read about AI parking systems in other cities and expected perfect service immediately. When we had technical problems or employee errors during the learning period, public criticism was harsh. This pressure made employees more anxious about making mistakes."*

The pressure of the public sometimes contradicted the gradual manner in which change management approaches would have been beneficial for employees to adapt, but collectively the challenges posed to demonstrate that implementing AI in municipal settings may need full change management strategies that account for technical, human, and organisational aspects, simultaneously. The research contributes to the literature by recognizing particular barriers at play in resource-constrained African municipal environments.

VIII. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8.1 Summary

This study explored workforce transformation after the introduction of AI into Gweru City's city parkade through a multimethod case study. It showed new challenges as traditional job roles were eliminated or transformed, with new digital monitoring roles emerging. Employee satisfaction varied significantly based both on the success of their adaptation to new work demands and support they received in the transformation process.

The main research findings included the elimination or transformation of 74% of traditional city parkade attendant roles, while 21 new digital roles were developed. Skills gap analysis showed that 35% of the employees did not have basic digital skills, so comprehensive reskilling programs were needed. Experiential learning strategies were by far the most effective approach to develop skills, but realistic limits on resources constrained these efforts.

Performance increases occurred as well, with revenues up 39.6% and significant increases in productivity, but employee trade-off, particularly in delivering personal service to parking customers decreased, while employee well-being had very uncertain effects. Management strategies such as phased transformation and cross-training provided hope for challenges with managing related workforce change.

8.2 Conclusions

The study demonstrated that workforce transformation resulting from AI implementation in urban parkade systems involves following a systematic pattern of transformation requiring careful management of the technological and human aspects. While the operational efficiencies justify investments in AI, the economic imperative must be balanced against comprehensive reskilling and support to meet the needs of employees adapting to significant transformation.

This study demonstrated that workforce transformation processes in municipal organizations in Africa are different from workforce change reported in the developed world and these difference are critical, especially dealing with resource limitations and baseline digital literacy.

The local conditions and capacities represented in these contextual factors will dictate the variations of approaches in changing management that must reflect the local nature of these contexts.

Employee satisfaction during AI transformation is strongly linked to the quality of reskilling, clarity of communication, and perceived job security. The organisations implementing AI systems must tackle these aspects and approach it from a proactive perspective to ensure workforce satisfaction, and quality of service as the expected outcome during moments of transition.

The study will make to theoretical understanding of the impact on workforces from AI implementation by highlighting sector specific trends within municipal parking services. The study builds on existing frameworks by incorporating the perspectives of developing country contexts as well as bringing forward discussion of public sector dynamics which are often overlooked within the literature of technological adoption.

8.3 Recommendations

The following recommendations are put forth from the results of this research for municipal authorities that are planning to implement AI systems in their parking strategies:

8.3.1 Strategic Recommendations

Phase in Approaches to Implementation: The use of a phased approach removes the expectation of a fully transformed workforce, allows for adaptive learning while limiting disruption to the workforce. These phased approaches can include piloting prior to full implementation.

Invest Meaningfully in Reskilling: It is best practice to focus on doing rather than traditional classroom training by experiencing "doing." Determining adequate fund, time and spatial resource allocations to develop sustained skills development programming for all employee needs.

Develop clear and transparent communication strategies: Clear and consistent communication should be provided regarding changes as well as the timeframes associated with changes and expectations in terms of employment. It is preferable to proactively address these issues than to reactively address concerns.

8.3.2 Operational Recommendations

Engage in Cross-Training Programmes: The workforce is usually more flexible when it equitably develops skills across traditional parking and all of the digital parking operations. This will enhance adaptability and reduce job insecurity.

Develop Performance Tracking Systems: Track technical systems performance and employee wellbeing indicators. Use data to monitor challenges and introduce timely changes to support programming.

Develop Mentoring Networks: Develop mentorship pairings between employees who are digitally skilled and employees needing support. Experiences indicate mentoring between peers learning together is more effective than formal training.

8.3.3 Policy Recommendations

Address Infrastructure Preconditions: Full AI deployment cannot begin using AI systems without reliable power supply and ICT infrastructure. Consequently the reliability of these systems will have both operational and psychological implications (employee confidence).

Develop Inclusive Training Policies: Develop targeted support programming (and capacity building) for disadvantaged groups, including older employees and workers with limited formal education. All activities associated with transformation must consider equity.

Develop Change Management Strategies: Develop systematic ways of managing organizational change, recognizing that organizations can need to integrate technology considerations with human resource considerations. In some situations the services of professional change management expertise may be required.

8.3.4 Future Research Recommendations

Undertake Longitudinal Studies: Detailed studies that follow patterns of workforce transformation over long

periods of time will demonstrate how far teams and organizations have adjusted to new ways of serving municipalities, and identify issues with adaptation that are subsequently revealed;

Examine cross-case application of comparative perspectives: Examine the pattern of AI implementation and use of AI systems in a number of African cities and contexts, which will assist in generating more generalizable patterns and recurring problems and factors contributing to success.

Examine citizen expectations: Look at the increased use of AI systems in the municipality and citizen satisfaction related to parking services regarding the preference of less human contact with some aspects of parking services, as well as the increased personalization of services that can occur with AI.

8.4 Limitations

Limitations of this study include that it was conducted using a single-case research design, thus the findings should be interpreted with caution given the limited transferability to alternate contexts. The single-case was conducted over an 18-month period, which is possibly inadequate to capture long-term change effects on the transformation in workforces. The research was limited by the inability to track workers for the full longitudinal period, as there were insufficient resources to sensibly identify the outcome of employee career paths.

The research emphasized municipal employee perspectives and thus rarely examined broader community impacts of technological change, or citizen experiences with AI-enabled parking systems. Future research need to address these gaps in the literature to provide a fuller understanding the society impacts of AI implementation in municipalities.

Despite the limitations of the study the research emphasises the importance of the challenges and potential opportunities associated with workforce transformation in AI-enabled urban services, and will allow for additional thoughtful approaches to technological changes management process to progress in a developing country contexts.

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