

Technological Challenges Facing Biometric Attendance System Implementation in Public Sectors in Tanzania: A Case of National Housing Corporation (NHC)

Musa P. Kamendu and Dr. Thadei Kiwango

Abstract

Using a biometric attendance system is vital for systematically managing staff attendance. Despite the significance of this system, however, there are technological challenges restraining the effective implementation of the system in many organisations in Tanzania. In this regard, the researcher intends to assess the challenges of biometric attendance systems implementation in public sectors in Tanzania, a case of the National Housing Corporation (NHC). The sample 205 employees were sampled from a total of 431 NHC employees. The study employed a descriptive research design and quantitative research approach to meet the study objective. Stratified random sampling and simple random sampling techniques were used to select a sample for the study. Data were collected using structured questionnaires and were analysed through descriptive statistics analysis with the aid of SPSS version 22. The study found that technological factors affect the implementation of the biometric attendance system at NHC. The findings categorically found that electricity/power supply also influences or affects biometric attendance system implementation at NHC with the mean score of $M=3.80$ and $S. D=0.495$. The findings imply that electricity/power supply affects biometric attendance system implementation and can affect the whole process of employee attendance. The study recommends that training employees at NHC on the proper usage of the biometric system should continue. NHC staff are recommended to be ready to accept new technology as resistance deters effective achievement of the purpose of purchasing biometric systems. Lastly, leaders at NHC should be the first pioneer to use biometrics in order for followers to follow them.

1.0. Introduction

Biometric technology has gained much popularity in the market for both publicly owned organisations and private organisations. This has been attributed to the needs of these organisations, especially on security issues and attendance monitoring purposes (Mandari & Koloseni, 2016). The use of biometric technology for attendance monitoring purposes has been mostly applied in educational institutions, industries, airports, borders, Automated Teller Machines (ATM) for authentication, in jail management to maintain criminal attendance and records, and in other workplaces (Bais et al., 2016; Mandari & Koloseni, 2016).

Many organisations applied the use of a biometric attendance system to replace the manual system due to various advantages offered by this system. The biometric attendance system helped in eliminating employee time theft and increased productivity which in turn increases raise profits while minimising labour costs. The use of a biometric attendance system is more convenient in terms of time-consuming for the employees and the ones who are monitoring the attendance compared to the use of the manual practice. It also helps in the provision of accurate labour data to the payroll system, and hence it enhances the work culture and overall efficiency in the organisation (Mir et al., 2018).

Biometrics are used in a wide range of industries worldwide. In a 2018 research, German and Barber from the Center of Identity at the University of Texas at Austin identified financial services, technology, and government as the top three industries worldwide that use biometric technologies. This is followed by the employment, leisure, and healthcare sectors, with education seeing the least usage. An individual can use a mobile wallet to make purchases in the financial services and technology sectors. This is due to the fact that the majority of modern mobile phones include a biometric scanner. Apple Pay or Samsung Pay can be used to pay for in-store or online purchases by linking a credit card to a mobile wallet. While Samsung Pay uses the fingerprint or iris for authentication, Apple Pay uses Face ID or Touch ID. Additionally, the banking sectors are implementing biometric methods to verify their clients at ATMs. For instance, "Know-Your-Customer" facial recognition technology is present in roughly 90% of ATMs worldwide.

Biometric attendance systems have been globally applied to a great extent by various organisations in the management of employee attendance through maintaining attendance records of people in an institution or an organisation (Bais et al., 2016). The technology has gained popularity due to its simplicity of use and ability to identify each person specifically, which has persuaded numerous businesses to implement it (Ahmad et al., 2012). Biometric technology has been designed with the ability to recognise people's unique

physiological and behavioural characteristics, and hence it can be applied to monitoring employee attendance efficiently (Mir et al., 2018).

Biometric technology did not arrive in Africa until the early 2000s, when it was still in its infancy. Biometric systems began to rely on observable physiological or behavioural traits that may be used to identify or confirm a person's identification (Hoo & Ibrahim, 2019). Hand geometry, hand vein, ear shape, fingerprints, retina, iris, and facial recognition systems are examples of physiological-based biometric systems (Hoo & Ibrahim, 2019). On the other hand, behavioural biometric qualities, such as voice recognition, keystroke dynamics, signature verification, and gait analysis, were taught and gained over time before stabilising (Ahmad et al., 2012). According to Dey et al. (2014), the biometric attendance system was initially applied through the use of fingerprints or face images/video.

In Tanzania, the introduction of biometric attendance systems can be traced back to the 2005's when law enforcement agencies applied the systems purposed for identifying criminals through fingerprint recognition (Ahmad et al., (2012). The organisations or companies in Tanzania are feeding the biometric data of their employees into the devices, and then this data is used as the reference for authenticating the right employee for making attendance on the device. Through this system, the attendance of employees can be monitored electronically on a real-time basis or can be retrieved at the agreed specific time (Said et al., 2014). Basically, the system has replaced the manual attendance system used by various organisations previously.

Basically, various studies conducted on biometric attendance systems agreed that the system helps organisations or companies to monitor employees' attendance effectively and efficiently (Kirmani, 2017). The main objective of the public sector in Tanzania to attend to its employees is to maximise productivity and increase employee relations (Morosan,2016). Despite the efforts to reinforce the use of a biometrics attendance system to track employee attendance, many employees' in Tanzania perceive its adoption negatively (Cupido, 2011).

This provides a good reason for conducting a study to examine technological challenges for biometric attendance system implementation in Tanzania, a case of the National Housing Corporation (NHC).

2.0. Literature Review

2.1. Theoretical Literature Review

Technological acceptance model

Davis (1995) built the Technology Acceptance Model (TAM) on the Theory of Reasoned Action. TAM is an information systems theory that simulates how technology adoption and usage occurs among people. It refers to how much a person thinks using a given system will be effortless.

By analysing and examining aspects impacting the acceptance of specific information technology, this model aims to explain and forecast the acceptability of information technology. Perceived usefulness (PU) and perceived ease of use (PEOU) are two criteria that can influence attitude, according to TAM. TAM claims that behavioural intention has a significant and positive impact on actual behaviour. The model reveals that there was a large and positive correlation between how often employees used the software and how valuable they thought it was (Neil, Walter & Boot, 2016).

Since new technologies like personal computers are challenging and there is some uncertainty over their effective adoption, people form attitudes and intentions about trying to learn how to use them before beginning activities directed toward using them. It is possible for attitudes and intentions to be unformed or unconvinced, or they may not form until after making some early attempts to learn how to use the technology. Therefore, these beliefs and intentions might not have an immediate or direct effect on actual usage (Rosli & Songip, 2017).

The theory, therefore, is directly related to the study under investigation since the study is about the challenges of biometric attendance systems implementation in public sectors in Tanzania, a case of the National Housing Corporation (NHC). The study seeks to know how the biometric attendance system application has an effect on the performance of public institutions. Thus, through this theory, the researcher will be able to achieve the main objective of the study and come up with recommendations.

2.2. Empirical Literature Review

Technological challenging factors for biometric implementation

By gauging the timeliness of the staff at the educational institutions, Kirmani (2017) examined the effects of the biometric attendance system on the educational system. The study's conclusions showed that, despite some flaws in the biometric attendance system, biometric modalities are generally reliable and secure. Some of these issues included the stakeholders' lower acceptability of the biometric acceptance system and an insufficient electrical power supply to meet the system's consumption needs, which interfered with its efficient operation (Chong et al., 2009). Include information sharing cultural characteristics as a new element in the adoption research and add innovation qualities (relative advantage, compatibility, and complexity) to the TOE framework. Relative advantage, compatibility, cost, and security issues from DOI were coupled with the TOE framework by Zhu et al. (2006a). The TOE framework gains relative advantage, complexity, and compatibility from DOI, according to Wang et al. (2010).

Morosan (2016) conducted research on the advantages and disadvantages of biometric travel systems. The study found a number of potential, including identity management, more convenience, and improved human resource management, that biometric technology present to the travel sector. However, the study also found that some user acceptance issues with biometric attendance systems included concerns about privacy, the risk of injury from system use, and overall user anxiety. According to the National Research Council and Whither Biometrics Committee report from 2010, social, cultural, and legal factors may have an impact on how well a biometric attendance system performs or whether it is even used at all.

According to Yonazi (2012), problems in implementing biometric attendance in Tanzania included risks to data, equipment, networks, and people, as well as the corresponding measures meant to mitigate them. The biometric system becomes even more crucial as Tanzania experiences an increase in ICT breakthroughs and advancements. Tanzania's technology infrastructure is still insufficient for the nation to have appropriate cyber security. This is due to how long ago the technological infrastructure was created compared to computer technology. The system was developed to support the conventional attendance-based workplace. For all types of biometric applications, security and timeliness were important concerns. This issue was made worse in developing nations like Tanzania by inadequate and outdated ICT systems

(Pani and Agrahari, 2017). Tanzania must expedite the creation and implementation of a thorough framework to ensure safer biometric systems there (Yonazi, 2012).

According to Suhail (2017), the use of ineffective technology made it difficult to embrace biometric systems since many smaller rural Internet service providers (ISPs) lack the expertise and technical know-how required to implement the most effective technologies. For instance, a straightforward billing method was crucial. An ISP with technological capability could implement Open Source Software (OSS) to successfully carry out this task. Without these abilities, an ISP was forced to use more expensive proprietary software, raising expenditures and operating expenses. Some ISPs did not implement technology, like bandwidth management systems, to optimise the use of their resources. As a result, the network becomes congested, forcing the ISP to buy more bandwidth. Once more, customers bore the additional costs rather than merely using the limited resources more wisely.

In addition, Ahmad et al. (2012) documented some challenges of the biometric attendance system, including some of the fingerprints of staff working in the laboratory, are affected; age also affecting the use of voice in the biometric system, and some diseases also affect the eyes of the individual which affect the biometric attendance system implementation. The study found that the implementation of the biometric attendance system requires a high cost with a high cost in the maintenance of the system itself.

Iqbal and Qadir (2012) conducted a study on biometrics technology with the main aim of exploring and clarifying influencing factors and attitudes concerning biometrics security technology. The study employed the use of informal interviews by gathering expert opinions and using web-based surveys. The findings revealed that people have trust in the biometrics system, and as the users, they have accepted the system and are ready to adopt the implementation of the biometric system.

Ali et al. (2018) studied the relationship between the biometric attendance system with teachers' performance at Hazara University. The study contacted 150 employees who were selected through stratified random sampling. The results showed a positive employee attitude towards the installation of a biometric attendance system. In addition, the findings revealed that biometrics ensure teachers' attendance on time, and hence it influences the employees' performance.

Trabelsi and Shuaib (2011) studied the implementation of a biometrics-based student attendance system. The study aimed to discuss the design, implementation and evaluation of biometrics in recording the attendance of students by using both fingerprint and iris readers. The findings revealed that the e-

attendance system helped to drop the absenteeism rate among the students, and in addition, the system has provided a reliable solution to prevent any student impersonation resulting from fake attendance.

3.0. Methodology

In the course of conducting this study, a researcher employed a quantitative approach. The research design that seems to be appropriate for the study is the descriptive research design which answers the questions of what, where, when and how but not why (Cresswell, 2012). The study was categorically conducted at NHC, a location that was easy for the researcher to access and collect the required data for the study. The study population involved staff from NHC in the Dar Es Salaam region, with a total number of 431 employees. Out of the total population, a sample size of 205 respondents was obtained. The study employed stratified random sampling whereby respondents were grouped into strata according to their departments, and then a sample was drawn randomly from each stratum. A structured questionnaire with a 5-point Likert scale that had closed-ended questions was employed in this study. In analysing data, the study applied descriptive statistics analysis techniques through a mean, percentage and standard deviation. Specifically, Statistical Package for Social Sciences (SPSS) version 22 was used as a tool for data analysis.

4.0. Findings

The aim of the study was to determine the technological challenges for biometric attendance system implementation at NHC. Using a five-point Likert scale, the study thought to know respondents' rate of agreement on various statements relating to technological challenges for biometric attendance system implementation at NHC.

Under this research objective, the researcher sought to determine the technological challenges for biometric attendance system implementation at NHC. Respondents were to respond by ticking the most appropriate option ranging from 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree. Respondents indicated their perception toward three items in the questionnaire, as shown below. The scale of mean score interpretation was as follows: Based on the mean values, the mean score of 1 to

1.8 represent strongly disagree, 1.81 to 2.60 represent disagree, 2.61 to 3.40 represent neutral, 3.41 to 4.20 represent agree and 4.21 to 5.00 represent strongly agree.

Table 1: The Technological Challenges for Biometric Attendance System Implementation at NHC

Statements	N	Mean	Std. Dev	Interpretation
Equipment	205	3.13	.570	Neutral
Network	205	2.83	.663	Neutral
Electricity/power supply	205	3.80	.495	Agree

Source: Field Data (2022)

As reflected in Table 1, the mean score differed from one item to another. This shows that respondents had different opinions about how technology affects biometric attendance system implementation at NHC. Specifically, they were neutral that equipment and network can affect or influence biometric attendance system implementation at NHC in one way or another (M=3.13 and S. D= 0.570) and (M=2.83 and S. D=0.663), respectively.

The findings further indicated that respondents agreed that Electricity/power supply also influences or affects biometric attendance system implementation at NHC, with the mean score of M=3.80 and S. D=0.495. The findings imply that electricity/power supply affects biometric attendance system implementation and can affect the whole process of employee attendance.

Both the public and private sectors are increasingly utilising biometric technology and systems. Biometric technologies (such as voice, iris, fingerprint, or facial identification technologies) are becoming more affordable, sophisticated, and precise.

According to the majority of employees, it can be concluded that implementing biometrics has improved service delivery; nevertheless, in most underdeveloped nations like Tanzania, the obstacle is a power problem, network problem, and equipment issue. Giesing (2003) asserts that people accept biometrics

when they bring value to service delivery, such as a security component and greater accessibility through speed and ease of use.

5.0. Discussion

The study question's findings revealed that while the idea of attendance systems has persisted over time, its application has changed recently. The usage of biometric systems has begun at NHC due to its awareness of the significance of personnel attendance and the challenges presented by manual attendance methods. Particularly, fingerprint and face recognition are the two most used biometric identification methods since they are thought to be the most safe and dependable due to their individuality. NHC evaluates its control methods for personnel attendance in order to incorporate modern technology into its operations because manual attendance techniques are time-consuming and ineffectual. In practise, it has been shown that biometrics encourage openness and employee performance despite its many difficulties with equipment, power, and network issues.

The results support Villaroman et al(2018) 's assertion that biometrics encourage transparency to the organisation by allowing it to preserve the length of employees' preparation records because the system updates continually in real-time. By implementing BARS, the company saved numerous resources that would have been used to track employee attendance. The result is an improvement in work performance. The organisation employs biometrics system time and attendance clocks to provide human resources staff more time to handle employee absences and find ghost employees, therefore the adoption of biometrics will have a big impact on their attendance (Villaroman et al., 2018).

Additionally, Villaroman et al. (2018) came to the conclusion that the majority of employees believe that using the Biometric Attendance Recording System (BARS) has a positive impact on work performance and that the biometrics-based results showed a significant increase in employees' level of performance. Giesing (2003) asserts that people accept biometrics when they bring value to service delivery, such as a security component and greater accessibility through speed and ease of use.

6.0. Conclusion

From the above discussion, it can be deduced that technological challenges affect the implementation of the biometric attendance system at NHC. The findings further concluded that electricity/power supply also influences or affects biometric attendance system implementation at NHC, with a mean score of $M=3.80$ and $S. D=0.495$. The findings imply that Electricity/power supply affects biometric attendance system implementation and can affect the whole process of employee attendance.

7.0. Recommendation

The study recommends the following;

Training of Employee

The usage of biometrics should continue to be covered in employee training by NHC. Training is required when the system is first introduced, just like with any other technology that people are unfamiliar with. When users are assisted and instructed when using the biometrics authentication system for the first time, this can spark interest in utilising the system. Users that receive training are given a basic understanding of the system's capabilities and the fundamental procedures for interacting with it. Since all biometrics systems perform essentially the same tasks, users will not need any additional training when a new biometrics feature is introduced. For example, if an organisation switches from facial authentication to fingerprint authentication, no training is necessary because the biometrics systems' similar functions allow for uniform biometrics training across the board.

User Technology Acceptance

Staff at NHC should be open to embracing new technology. New technologies can be unforeseen and have unintended consequences. People usually do not use a system until they think it will help them execute their jobs better or, on the other side, until they see its value. Technology is a pervasive, sophisticated system with intellectual components that affects every facet of daily life. In this regard, the technology adoption model relates to an individual's beliefs and attitudes toward participating in an adoption process that may have an impact on user acceptance of biometrics as an identifying method.

Management Support

Leaders at NHC should be the first pioneer to use biometrics in order for followers to follow them. During the time in and time out, leaders should show examples by action.

8.0. Reference

- Adewole, K. S., Abdulsalam, S. O., Babatunde, R. S., Shittu, T. M., & Oloyede, M. O. (2014). Development of fingerprint biometric attendance system for non-academic staff in a tertiary institution. *Development*, 5(2), 62-70.
- Ahmad, S. M. S., Ali, B. M., & Adnan, W. A. W. (2012). Technical issues and challenges of biometric applications as access control tools of information security. *International journal of innovative computing, information and control*, 8(11), 7983-7999.
- Ali, A., Mustafa, J., & Khan, I. U. (2018). Relationship of Biometric Attendance System with Performance, Job-Related Stress and Satisfaction of University Teachers in Pakistan. *Liberal Arts and Social Sciences International Journal (LASSIJ)*, 2(2), 42-49.
- Bais, M., Rawat, D., & Kaur, G. (2016). Biometric attendance system circuit. *Int. Journal of Engineering Applied Sciences and Technology*, 1(6), 2455-2143.
- Chong, A.Y.L., Ooi, K.B., Lin, B.S. and Raman, M. (2009) Factors affecting the adoption level of c-commerce: An empirical study, "Journal of Computer Information Systems", Vol. 50, No. 2, pp 13-22.
- Cupido, U. (2011). MPA Thesis on the Implementation of a Time and Attendance System At Stellenbosch University, Germany.
- Dey, S., Barman, S., Bhukya, R. K., Das, R. K., Haris, B. C., Prasanna, S. M., & Sinha, R. (2014, February). Speech biometric-based attendance system. In *2014 twentieth national conference on communications (NCC)* (pp. 1-6). IEEE.
- Dulewicz, V. (2012). Assessment of Management Competences by Personality Questionnaires. *Selection and Development Review*, 8, 1–4.
- Dulewicz, V. & Higgs, M. (2015). Assessing leadership styles and organisational context. *Journal of Managerial Psychology*, 20, 105–123.

- Harakannavar, S. S., Renukamurthy, P. C., & Raja, K. B. (2019). A comprehensive study of biometric authentication systems, challenges and future trends. *International Journal of Advanced Networking and Applications*, 10(4), 3958-3968.
- Henry, E., Echa, E. A., & Alfred, M. (2017). The Importance and Challenges of Biometric Machines in School Supervision. A Case Study of Access High School, Calabar. *Equatorial Journal of Education and Curriculum Studies*, 2(2), 34-39.
- Hoo, S. C., & Ibrahim, H. (2019). Biometric-based attendance tracking system for education sectors: A literature survey on hardware requirements. *Journal of Sensors*, 2019.
- Hoogervorst, J., Flier, H., & Koopman, P. (2014). Implicit communication in organisations: the impact of culture, structure and management practices. *Journal of Managerial Psychology*, 19, 288–311.
- Hsu, P.F., Kraemer, K.L. and Dunkle, D. (2006) Determinants of e-business use in us firms, "International Journal of Electronic Commerce", Vol. 10, No. 4, pp 9-45.
- Iqbal, I., & Qadir, B. (2012). *Biometrics Technology: Attitudes & influencing factors when trying to adopt this technology in Blekinge healthcare*.
- Kirmani, M. M. (2017). Impact of Biometric Attendance System on Secondary and Higher Secondary Educational Institutions Across J&K. *Oriental journal of computer science and technology*, 10(2), 291-297.
- Liyanage, P. M. T., & Liyanage, C. M. (2018). Effectiveness of Using Biometric Attendance System (Fingerprint) In Public Sector: A Case Study of ABC University, Sri Lanka.
- Longman, A. & Guttman, H. M. (2016). Project teams: how good are they? *Quality Progress*, 39, 59–65.
- Mandari, H., & Koloseni, D. N. (2016). Biometric authentication in financial institutions: the intention of banks to adopt biometric powered ATM.
- Mark, S., Philip, L., & Adrian, T. (2009). Research methods for business students.
- Mir, G. M., Balkhi, A. A., Lala, N. A., Sofi, N. A., Kirmani, M. M., & Mir, I. A. (2018). The benefits of implementation of biometric attendance system. *Oriental Journal of Computer Science and Technology*, 11(1), 50-54.
- Morosan, C. (2016). Opportunities and challenges for biometric systems in travel: a review.

- Morrison, J. M., Brown, C. J., & Smit, E. (2016). The impact of organisational culture on project management in matrix organisations. *South African Journal of Business Management*, 39, 27–36.
- Morrison, J. M., Brown, C. J., & Smit, E. V. D. M. (2016). A supportive organisational culture for project management in matrix organisations: A theoretical perspective. *South African Journal of Business Management*, 37, 39–54.
- National Housing Corporation Strategic Plan for 2016 - 2025
- National Research Council, & Whither Biometrics Committee. (2010). *Biometric recognition: Challenges and opportunities*.
- Pani A and Agrahari A, (2007), *Biometrics in emerging economies: Theories and cases*, Idea group publishing, USA.
- Pellegrinelli, S., Partington, D., Hemingway, C., Mohdzain, Z., & Shah, M. (2017). The importance of context in programme management: An empirical review of programme practices. *International Journal of Project Management*, 25, 41–55.
- Raghu V. and Agrawal D. (2016). *To assess the utility of the biometric attendance system in improving the work efficiency of employees working in All India Institute of Medical Sciences, New Delhi*, *Sinhgad e-Journal of Nursing*, Vol. IV.
- Said, M. M., Misran, M. H., Othman, M. A., Ismail, M. M., Sulaiman, H. A., Salleh, A., & Yusop, N. (2014). Biometric attendance. In *2014 International Symposium on Technology Management and Emerging Technologies* (pp. 258-263). IEEE.
- Trabelsi, Z., & Shuaib, K. (2011). Implementation of an Effective and Secure Biometrics-Based Student Attendance System. *International Journal of Computers and Applications*, 33(2), 144-153.
- Waldersee, R., Griffiths, A., & Lai, J. (2013). Predicting organisational change success: matching organisation type, change type and capabilities. *Journal of Applied Management and Entrepreneurship*, 8, 66–81.
- Wang, Y.M., Wang, Y.S. and Yang, Y.F. (2010) Understanding the determinants of RFID adoption in the manufacturing industry, "Technological Forecasting and Social Change", Vol. 77, pp. 803-815.
- Yonazi J, (2012), *Biometric attending in Tanzania: Report on from the biometric Security Mini-Conference* (online): retrieved 31/12/2012:

Zhu, K., Kraemer, K.L. and Xu, S. (2006b), The process of innovation assimilation by firms in different countries: A technology diffusion perspective on e-business, "Management Science", Vol. 52, No. 10, pp 1557-1576.