RESEARCH IN MANAGEMENT OF TECHNOLOGY AND BUSINESS
e-ISSN: 2773-5044

RMTB

Vol. 7 No. 1 (2026) 581-594
https://publisher.uthm.edu.my/periodicals/index.php/rmtb

The Impact of Internet of Things (IoT)-Driven Digital Transformation on Workforce Dynamics in Facilities Management

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DOI: https://doi.org/10.30880/rmtb.2026.07.01.045

Article Info

Received: 31 March 2026
Accepted: 31 May 2026
Available online: 30 June 2026

Keywords

Facilities Management (FM),
Internet of Things (IoT),
Workforce Transformation,
Digital Skills.

Abstract

The rapid integration of Internet of Things (IoT) technologies is transforming facilities management (FM) in Malaysia, shifting operations from reactive, manual tasks to proactive, data-driven practices. This study investigates the impact of IoT adoption on workforce dynamics, identifies the challenges faced by FM employees, and explores strategies for managing workforce transitions in Kuala Lumpur. A quantitative descriptive approach was employed, collecting data from 111 FM employees which represents 85.38% response rate across roles such as technicians, engineers, supervisors, and managers. The findings reveal that IoT adoption significantly enhances workforce efficiency, collaboration, and data-driven decision-making while reshaping roles and skill requirements. Key challenges identified include job displacement, organizational resistance, skill gaps, and cybersecurity concerns, which may hinder effective adaptation. To address these challenges, respondents emphasized the importance of comprehensive upskilling programs, practical hands-on training, cross-department collaboration, clear management communication, skills assessment, incentive systems, and cybersecurity awareness initiatives. The study highlights the need for a human-centered approach to digital transformation, integrating employee development with technological implementation to ensure a smooth and sustainable transition. These insights provide practical recommendations for FM organizations, policymakers, and training providers to enhance workforce readiness, engagement, and adaptability, contributing to the successful adoption of IoT-driven operations and the advancement of smart building initiatives in Malaysia.

1. Introduction

Facilities Management (FM) sector in Malaysia is evolving due to the integration of Internet of Things (IoT) technologies, which are shifting FM operations from reactive, manual tasks to more proactive, automated, and data-driven processes (Whitmore *et al*., 2015). This digital transformation enables real-time monitoring, predictive maintenance, and smarter decision-making, significantly improving building efficiency and user experience (Atkin & Bildsten, 2017). However, despite these advancements, challenges such as workforce resistance, limited digital skills, and cybersecurity concerns continue to hinder adoption (Al-Sulami *et al*., 2024). As FM roles grow more strategic, there is a critical need for upskilling, employee engagement, and cross-department collaboration to ensure successful implementation. This research focuses on understanding how IoT is affecting workforce dynamics in FM and aims to provide strategies that support a smooth and sustainable transition.

The rapid rise of digital technologies like the Internet of Things (IoT) is reshaping many industries, including Facilities Management (FM). Traditionally, FM involved manual, reactive work such as maintenance, cleaning, and building operations (Atkin & Brooks, 2015). However, the industry is now moving toward smarter, data-driven practices that improve building performance and support broader goals like energy efficiency and sustainability (Jensen *et al*., 2016). In Malaysia, despite some progress, many FM organizations still rely on outdated systems, leading to inefficiencies and slow responses (Ismail *et al*., 2016). Upgrading to digital tools such as Computerized Maintenance Management Systems (CMMS) and IoT platforms is crucial for improving service quality and reducing operational burdens (Olanrewaju *et al.*, 2023).

However, adopting IoT in FM also brings challenges especially for the workforce. Many FM employees lack the digital skills needed to operate and manage smart technologies effectively (Shukor *et al*., 2023). Factors such as limited training, insufficient infrastructure, and unclear strategies make it harder for FM teams to adapt (Alharthi *et al*., 2023). While much research has focused on the technical benefits of IoT, there is a lack of studies exploring its impact on FM employees' roles, skills, and workplace experience, especially in Malaysia. This study aims to fill that gap by examining how IoT-driven transformation affects workforce dynamics and offering strategies to support employee upskilling and organizational readiness.

Although digital technologies are well-adopted internationally, many FM operations in Malaysia are on manual and reactive systems causing operational inefficiencies, delayed responses, and limited data-driven decision-making (Abu Bakar & Kamaruzzaman, 2023; Shuhaimi et al., 2024). Studies have reported that the pace of digitization in FM is slow, especially for public and institutional facilities because these systems were built many years ago and cost a lot to digitize. Although solutions provided by IoT technologies apply predictive maintenance, real-time monitoring, and automatic control, these pose challenges to FM personnel during implementation. Limited digital skills, inadequate training, organizational resistance, and cybersecurity concerns hinder effective technology utilization and reduce workforce confidence during the transition (Hassanain *et al*., 2025; Alrubaidi, 2024).

Most studies discuss the technical advantages of IoT in FM: better operations production, higher system performance, etc.; however, little has been addressed about the workforce impact, especially in Malaysia (Atzori et al., 2010; Whitmore et al., 2015; Shuhaimi et al., 2024). This clearly indicates the lack of empirical studies focusing on employee adaptation, role changes, and skills development, which this study intends to fill.

The research will thus focus on how IoT changes workforce dynamics concerning job responsibilities, the digital skills required by employees, the ability of employees to adapt to new technologies, and the usage of data in everyday decision-making. The human implication of digital transformation in FM receives priority over the technical or performance-based outcomes of IoT systems. This includes assessing training requirements, identifying challenges faced during the transition, and understanding how collaboration is changing in a tech-enabled environment (Shukor *et al.,* 2023; Alharthi *et al*., 2023).

The limited area of research exploration presents contextually relevant information about one of the rapidly developing regions of Malaysia. There has been increased investment into smart infrastructure and public-sector initiatives in Kuala Lumpur, which has become a place to study how digital transformation would affect FM workers. The Study intends to support local readiness for Industry 4.0 and to conform to national goals such as Malaysia's Smart City initiatives and Sustainable Development Goal 11 to create inclusive, resilient, and sustainable urban communities (MAMPU, 2020; WEF, 2021).

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2. Literature Review

This literature review provides a brief overview of research done on IoT and other digital technologies and their impact on facilities management and the people engaged in it. The aim of the paper is to give some background information, explain key concepts such as IoT, BIM, digital twins, and Industry 4.0, and showcase how these tools render the management of buildings more efficient. The study also looks at challenges including skills requirements, resistance to change, and data security. In reviewing what has been established by other researchers, this section provides the justification for this research and its contribution to knowledge in this area.

2.1 Facilities Management in the modern era

Facilities Management has undergone a paradigm shift from being traditionally maintenance-centered to becoming a fully strategic, integrated role that pulls together people, processes and the built environment in the current world. Thus, digital technology developments such as Building Information Modeling (BIM), the Internet of Things (IoT), Artificial Intelligence (AI), and Computerized Maintenance Management Systems (CMMSs) have formed the role of FM in achieving operational efficiency, sustainability and occupant well-being. All these have opened the FM scope from a purely reactive practice into an entirely proactive approach supplemented by data-driven decision-making, although numerous skills, training and technology adaptation challenges still linger (Atkin & Brooks, 2015; Jensen *et al.,* 2016; Brazauskas *et al*., 2021; Manap *et al*., 2024). Table 1 below summarize the literature findings related to FM in modern era.

Table 1 *Facilities Management in the modern era*

Main Point	Description	Author(s)
(a) Definition of Facilities Management and Facilities Managing	FM involves managing the physical workplace, people, and processes. Traditionally reactive and maintenance-based, FM has now become strategic and tech-enabled, focusing on efficiency, sustainability, and user well-being.	Atkin & Brooks (2015); Kincaid (2016); Jensen, van der Voordt & Coenen (2016); Atkin & Bildsten (2017)
(b) Traditional Roles and Responsibilities	FM used to be labor-intensive and reactive, focusing on basic building functions. It lacked strategic influence and relied on basic technical knowledge. The shift toward tools like CMMS and EMS paved the way for smarter operations.	Atkin & Brooks (2015); Kincaid (2016); Jensen et al. (2019); Ryan et al. (2016); Akinci et al. (2018)
(c) Evolution Toward Smart Facilities Management	FM has become more strategic due to digital tools like BIM, IoT, and AI. These technologies help monitor systems in real-time, improve building performance, and enable proactive decision-making. However, training and adaptation are still needed.	Dahanayake & Sumanarathna (2022); Manap et al. (2024); Brazauskas et al. (2021); Codinhoto et al. (2023)
(d) Technological Innovations in FM	Modern FM relies on BIM, AI, IoT, and CMMS to manage buildings more efficiently. These tools help prevent issues, reduce costs, and improve collaboration. Challenges include cost, cybersecurity, and skill gaps.	Manap et al. (2024); Brazauskas et al. (2021); Codinhoto et al. (2023)

2.2 Internet of Things (IoT) in Facilities Management

Digital transformation within Facilities Management (FM) has largely evolved due to the Internet of Things (IoT), allowing buildings to be operated in a more intelligent, efficient, and responsive manner. IoT brings to bear connected devices, such as sensors and actuors, smart systems, that enable real-time monitoring, predictive maintenance, energy optimisation, and improvement in occupant comfort. However, the adoption of IoT presents challenges for performance and sustainability in FM, such as cybersecurity issues, system integration, and workforce readiness, all of which highlight the need for well-trained FM personnel and supportive organisational strategies (Whitmore *et al*., 2015; Atzori *et al*., 2017; Fernandez *et al.,* 2021;

Huang *et al*., 2023). Table 2 below shows the literature findings related to IoT in FM.

Table 2 *Internet of Things (IoT) in Facilities Management*

Main Point	Description	Author(s)
(a) Definition and Core Concepts of IoT	IoT refers to connected devices like sensors and actuators that collect real-time data to support smart, automated FM tasks. It enables data-driven decisions, predictive maintenance, and energy efficiency. Core elements include connectivity, data processing, and automation. Despite its benefits, challenges such as cybersecurity and workforce readiness persist.	Whitmore *et al.* (2015); Shin (2014); Razzaque *et al.* (2016); Boyes et al. (2018); Atzori *et al.* (2017)
(b) IoT Applications in Facilities Management	IoT is used in FM for predictive maintenance, smart energy management, and indoor environmental monitoring. It helps detect early equipment issues, optimize resource use, and improve occupant comfort. Real-world examples include university campus applications and dual-purpose monitoring systems.	Fernandez *et al*. (2021); Tushar *et al*. (2016); Huang *et al.* (2023); Anik *et al*. (2021); Zakka & Lee (2025)
(c) Benefits and Challenges of IoT in FM	Key benefits include cost savings, energy efficiency, sustainability, and improved building performance. However, challenges include high setup costs, integration issues with legacy systems, cybersecurity risks, and the need for employee training. Kuala Lumpur's smart building initiatives, including UM's Smart Campus, demonstrate successful local IoT implementation.	Fernandez *et al*. (2021); Tushar *et al.* (2016); Huang *et al*. (2023); Elkhodr *et al.* (2016); Conti *et al.* (2018)

2.3 Impact of IoT on Workforce Dynamics in Facilities Management

In Facilities Management, IoT adoption is changing the dynamics of the workforce through the automation of routine work, predictive maintenance, and real-time, data-based decision-making toward enhanced efficiency, collaboration, and resource management. This digital change creates an entirely different skill set, requiring FM team members to cultivate knowledge in data analytics, cybersecurity, digital system management, and interdepartmental collaboration for survival in smart building atmospheres (Ali *et al*., 2021; Chen *et al.*, 2018; McKinsey, 2021; Hassanain *et al*., 2024; Quinn *et al*., 2022). Table 3 below shows the literature findings related to impact of IoT on workforce dynamics in Facilities Management

Table 3 *Impact of IoT on Workforce Dynamics in Facilities Management*

Main Point	Description	Author(s)
(a) Workforce Efficiency and Productivity	IoT automates routine tasks like equipment monitoring, reduces manual work, and enables predictive maintenance, improving FM efficiency. Cloud-based systems allow remote access, saving time and costs. Data-driven insights also support better space and resource planning.	Ali *et al.* (2021); Samatas *et al*. (2021)
(b) Enhanced Collaboration through IoT Platforms	IoT platforms improve collaboration across FM, IT, and building occupants by offering real-time dashboards and alert systems. Teams can act on live data for quicker decisions and fewer disruptions. Integration with BIM creates digital twins for smarter planning and improved tenant interaction.	Hassanain *et al*. (2024); Ling & Tam (2022); Lee & Kim (2018); Merzouk *et al.* (2023); Sustainability (2024)

(c) Data-Driven Decision-Making	IoT, BIM, and predictive analytics are transforming FM from operational support to strategic decision-making. These technologies enable FM employees to leverage real-time data and integrated building information to anticipate system failures, optimize asset performance, and improve service delivery. As a result, FM functions are increasingly aligned with organizational objectives, supporting long-term sustainability, cost efficiency, and informed management planning.	Chen *et al*. (2018); Ali *et al.* (2021); Roskams & Haynes (2019); Razali *et al*. (2021); Rahman *et al*. (2025); Parker *et al.* (2024); Nota *et al.* (2021); Hakimi *et al*. (2024)
(d) Shift in Skill Requirements and Roles	The digital shift in FM demands new skills like data analysis, cybersecurity, and digital system management. Roles such as smart building analysts are emerging. FM employees also need soft skills to collaborate across departments and align building operations with organizational goals.	McKinsey (2021); Quinn *et al.* (2022); Dahanayake & Sumanarathna (2021)

2.4 Challenges in IoT Integration for the Workforce

Integrating IoT in Facilities Management presents workforce challenges, including organizational resistance to change, skill gaps, and the need for training in digital systems, data analytics, and cybersecurity, which require strong leadership and a culture of continuous learning. Additionally, concerns over data security, privacy, and potential job displacement highlight the importance of reskilling and role adaptation to ensure FM employees can thrive in increasingly automated and technology-driven environments (Al-Sulami *et al.,* 2024; ProFMI, 2021). Table 4 shows the literature findings related to challenges of IoT Integration for the workforce.

Table 4 *Challenges of IoT Integration for the Workforce*

Main Point	Description	Author(s)
a) Organizational Resistance to Change	Employees may resist IoT due to fears of job loss, lack of involvement in change, or low digital confidence. Many organizations also hesitate due to reliance on legacy systems and cultural resistance to innovation. Leadership support and inclusive strategies are critical for smoother transitions.	Al-Sulami *et al.* (2024); Laumer *et al*. (2016); Wiese *et al*. (2024)
b) Skill Gaps and Training Needs in FM	FM employees often lack training in data analytics, digital systems, and cybersecurity. While organizations are investing in upskilling through IFMA certifications and e-learning, challenges such as budget limits and outdated attitudes persist. A culture of continuous learning is essential for digital readiness.	ProFMI (2021); Techtarget (2022); FM Middle East (2021); Plant Services (2023); Wiese *et al.* (2024)
c) Data Security and Privacy Concerns	IoT systems are vulnerable to cyber threats due to weak security setups. FM employees must now handle legal compliance (e.g., GDPR, HIPAA) and cybersecurity responsibilities. Training and layered security approaches like encryption, updates, and anonymization are needed to safeguard systems and data.	Mdpi (2020); ISACA (2019); PECB Insights (2020)
d) Job Displacement and Role Redefinition	Automation may displace low-skilled jobs, but it also creates new roles requiring complex decision-making and digital fluency. With reskilling, workers can adapt to these shifts. Collaboration between industry and educators is key to workforce transformation.	World Economic Forum (2018); Autor (2015); Taska (2020)

2.5 Strategies for Managing Workforce Transitions in Facilities Management

Assessed readiness to change in the workforce, skill gaps identified, and focused upgradation programs offered in practical, role-specific, and technology-enabled training. Encouraging cross-functional collaboration and knowledge sharing amongst FM, IT, HR, and operations would ensure smooth acceptance of digital initiatives, help to drive innovations and develop confidence in a tech-driven workplace (Deloitte, 2020; McKinsey, 2021; World Economic Forum, 2020, 2021).

Table 5 *Strategies for Managing Workforce Transitions in Facilities Management*

Main Point		Description	Author(s)
a)	Assessing Workforce Readiness and Skill Gaps	Evaluating employees' current skills through surveys, interviews, or digital assessments helps identify training needs. The aim is to align existing capabilities with future demands while fostering trust and engagement. Involving employees in the process ensures buy-in and promotes a growth mindset.	Deloitte (2020); World Economic Forum (2021); McKinsey (2021)
b)	Implementing Targeted Training and Upskilling Programs	Training must be practical, role-specific, and hands-on. Using modern tools like AR, simulations, or microlearning boosts engagement and knowledge retention. Continuous learning through certifications or partnerships with education providers keeps employees current and confident in a tech-driven world.	Innomaint (2023); Arxiv.org (2023); McKinsey (2021)
c)	Promoting Cross-Functional Collaboration and Knowledge Sharing	Collaboration between FM, IT, HR, and operations ensures smoother digital transitions and more user-friendly systems. Encouraging knowledge sharing through meetings, workshops, or internal platforms promotes innovation, agility, and a shared sense of responsibility for success.	World Economic Forum (2020); Deloitte (2020); McKinsey (2021)

2.6 Research Gap

IoT integration into facilities management (FM) is giving rise to a new breed of workforce, one that is skillful enough to automate routine tasks while requiring new aptitudes such as data analysis and systems management. The movement of FM employees into more strategic roles has been primarily driven by real-time data and AI tools, which are now being implemented toward enhancing space efficiency and workplace experience (CBRE, 2025). However, resisting such processes remains skill gaps and employee resistance, which underscore the need for training and collaboration with technology experts (Yarooms, 2023). Digital transformations can only be successful when supported by effective communication and participatory change management to keep teams engaged and prepared for the fast-evolving demands of smart building operations.

3. Research Methodology

3.1 Research Design

This study adopted a quantitative descriptive research design to examine how IoT integration impacted workforce dynamics in facilities management (FM). By collecting structured, numerical data through surveys, the research aimed to identify measurable patterns in areas such as employee adaptability, productivity, and digital skill development. This approach allowed for an objective understanding of current trends without influencing participant behavior, making it suitable for evaluating the real-world effects of IoT adoption. Drawing from similar studies such as Hizam *et al*. (2023), the design also explored factors like training, psychological readiness, and knowledge sharing, offering valuable insights into how FM employees in Kuala Lumpur coped with digital transformation.

3.2 Research Process

Figure 1 shows how this research will be conducted step by step:

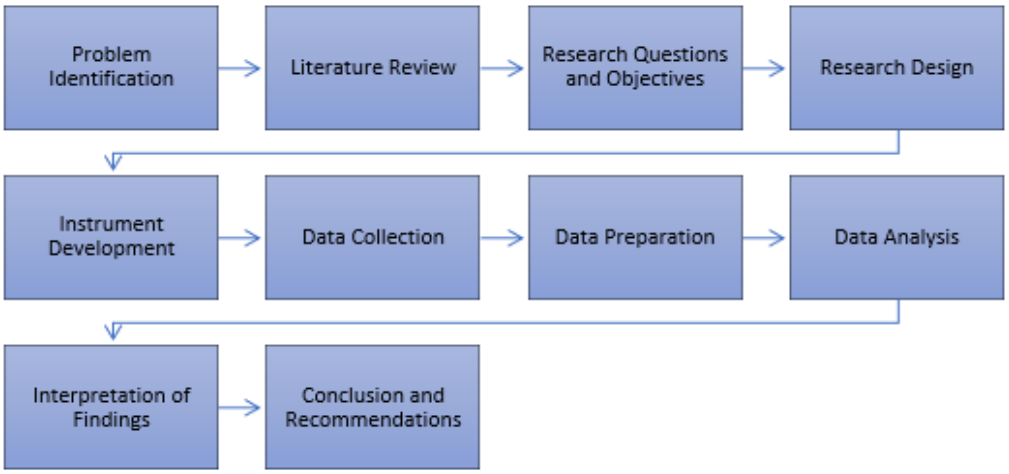

Figure 1 *Research Process*

3.3 Instrument of the Study

This research employed a structured online questionnaire for quantitative data collection targeted at facilities management (FM) employees around Kuala Lumpur. It contained both close-ended questions and Likert scale statement responses for standardized response and easy statistical analysis. Questions were grouped into 4 sections: demographic information, impact of IoT on workforce efficiency, challenges faced when integrating IoT, and recommendations to manage digital transitions. This ensured that the format was clear, consistent and relevant. Trustworthiness and validity of the instrument were further enhanced as it followed validated instruments in previous studies such as Alaloul *et al.* (2022) and Said & El-Gohary (2023).

Table 6 *Likert Scale (Likert, R.,1932)*

Scale	Interpretation
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

3.4 Targeted Population and Sampling Method

This study focused on a targeted population of facilities management (FM) employees in Kuala Lumpur, including contractors, technicians, supervisors, operational managers, and FM engineers who were directly involved in building operations and maintenance. These professionals were particularly relevant due to their exposure to Internet of Things (IoT) technologies, such as smart sensors, predictive maintenance systems, and digital monitoring platforms, making them ideal for examining workforce dynamics under digital FM. The total population was derived from Malaysian Association of Facilities Management (MAFM) registered staff, totaling 192 personnel, and the required sample size of 130 respondents was determined using the Krejcie and Morgan (1970) table as in Appendix A to ensure statistical reliability.

A purposive sampling method was applied to select participants who had relevant experience with IoT in FM. This approach allowed the study to focus on individuals whose roles involved direct interaction with digital systems and tools. Participants were identified through professional networks, LinkedIn profiles, industry associations (e.g., IFMA Malaysia), and referrals from smart-building projects. Purposive sampling was considered effective for understanding specific experiences and practices in contexts where only a subset of the workforce had the necessary expertise (Palinkas *et al.*, 2015; Etikan, Musa, & Alkassim, 2016). The chosen sample of 130 respondents ensured a statistically adequate representation for conducting quantitative analyses, including descriptive statistics, mean comparisons, and standard deviations.

3.5 Data Collection Method

3.5.1 Primary Data Collection

Data collection for this study was undertaken through structured online surveys targeting FM personnel in Kuala Lumpur. The survey contained several Likert-scale-based questions developed to measure areas such as the impact of IoT adoption and challenges experienced in digital transformation. The questionnaire was so designed that it could be filled via Google Forms to provide flexibility in participating. The study allowed the respondents to answer questions consistently, so that patterns and trends could more easily be identified among participants and first-hand perspectives on the experience of IoT in facilities management could be captured (Yawson et al., 2021).

3.5.2 Secondary Data Collection

Using secondary data were published scholarly journals, reports from industries, and case studies from the years 2014 through 2025, which helped provide a wider view of the application of IoT in FM and how it affects the workforce. There are differences in evaluating operational benefits and workforce implications of IoT, compared by Lu et al. (2019) and Brous et al. (2020). Industry reports from IFMA (2022) and Trax Analytics (2024) offer proven examples in their actual deployment. Credible sources not only lent credence to primary findings but also developed a full view into current trends on IoT and facilities management

3.6 Data Analysis Techniques

This study used descriptive statistics as the main technique to analyze the collected survey data. Descriptive statistics, including mean, frequency, and standard deviation, helped summarize the responses and highlighted general patterns or trends among FM employees regarding IoT integration. Tools like Excel and SPSS were used to process the data efficiently and accurately (Pallant, 2020; Field, 2018). These methods allowed the researcher to interpret how participants felt about IoT's impact on their roles, identify common challenges, and assess levels of readiness and training. This foundational analysis guided deeper insights and supported the overall research findings.

4. Results and Discussion

This section presents and discusses the results of the study based on quantitative data collected from FM employees involved in IoT-enabled facilities management. The findings are organised according to the research objectives, focusing on the impact of IoT-driven digital transformation on workforce dynamics, the challenges.

4.1 Respondent's Background

In order to help achieve all objectives, a total of 111 respondents were successfully obtained to answer the questions presented which involve an 85.38% response rate. Facilities Management workers that operate in the state of Kuala Lumpur contribute to the following category of respondents. The respondent must provide answers to multiple sections of the given questions. Table 7 provides an overview of the respondents' backgrounds who took part in this research.

Table 7 *Demographic Information of Respondents*

No	Respondents Category	Frequency	Percent%
1	Gender		
	Male	80	72.1%
	Female	31	27.9%

2	Age		
	Below 25 Years	32	28.8%
	25-34 years	55	49.5%
	35-44 years	21	18.9%
	45-54 years	2	1.8%
	55 years and above	1	0.9%
3	Position / Role		
	Technician	17	15.3%
	Supervisor	9	8.1%
	Engineer	12	10.8%
	FM Manager	11	9.9%
	FM Administrative	20	18.0%
	Assistant Technician	42	37.8%
4	Years of Experience		
	Less than 1 year	42	37.8%
	1-3 years	45	40.5%
	4-6 years	21	18.9%
	7-10 years	1	0.9%
	More than 10 years	2	1.8%

Based on Table 7, the respondents consisted mainly of male FM employees (72.1%), reflecting the current workforce composition within the facilities management sector. Most respondents were aged 25–34 years (49.5%), indicating that the study captured perspectives from a relatively young and active workforce. In terms of job roles, assistant technician (37.8%) and FM administrative staff (18.0%) formed the largest groups, followed by technicians and engineers. This suggests that IoT adoption influences a wide range of FM roles beyond technical positions alone. Additionally, most respondents had less than three years of experience (78.3%), implying a workforce that may be more adaptable to digital transformation initiatives such as IoT implementation. Overall, the demographic distribution of the 111 respondents provides a relevant and suitable basis for examining the impact of IoT-driven digital transformation on workforce dynamics in facilities management.

4.2 Impact of IoT-Driven Digital Transformation on Workforce Dynamics

Objective 1: To study the impact of IoT integration on workforce efficiency, collaboration, and data-driven decision-making.

Part B questions focused on understanding the impact of IoT on workforce dynamics in facilities management. Table 8 shows the level of mean measurement used to analyse the data in this study. The analysis of mean of each question is important to test the relative agreement among the respondent. After collecting data, the summary of responses regarding workforce efficiency, collaboration, decision-making, and skill shifts is presented in Table 9.

Table 8 *Level of mean measurement (Wiersma, 1995)*

Mean Range	Central Tendency Level
High	3.68-5.00
Moderate	2.34-3.67
Low	1.00-2.33

Table 9 *Impact of IoT on Workforce Dynamics*

Impact Dimension	Mean Score	Interpretation
1. Workforce Efficiency and Productivity	4.19	High
• IoT reduces manual work	4.19	High
• Sensors help prevent breakdowns		

• Remote access saves time	4.29	High
	4.09	High
2. Enhanced Collaboration through IoT Platforms	4.09	High
• IoT dashboards improve teamwork.		
• Shared data reduces mistakes.	4.09	High
• Occupants can give feedback easily	4.10	High
	4.09	High
3. Data- Driven Decision Making	4.09	High
• IoT data helps plan maintenance	4.09	High
• Dashboards support quick decisions	4.09	High
• IoT and BIM give better insights.	4.10	High
4. Shift in Skill Requirements and Roles	4.16	High
• FM staff need digital skills.	4.20	High
• New job roles appear with IoT	4.19	High
• FM must work more with IT or Finance	4.09	High

Table 9 shows that all impact dimensions record high mean scores, indicating that IoT-driven digital transformation has a strong influence on workforce dynamics in facilities management. Workforce efficiency and productivity emerged as the most significant impact (mean = 4.19), reflecting the ability of IoT technologies to reduce manual work, prevent system breakdowns, and save operational time.

The shift in skill requirements and roles ranked second (mean = 4.16), demonstrating that IoT adoption significantly changes the competencies expected of FM employees. This highlights the growing need for digital literacy and cross-functional collaboration in FM roles. Enhanced collaboration and data-driven decision-making, although still rated high, recorded slightly lower mean scores, suggesting that their effectiveness depends not only on technology but also on organisational culture and employee readiness.

4.3 Challenges of IoT Integration for the Workforce

Objective 2: To identify the challenges employees encounter during the shift toward IoT-based operations.

Part C questions focused on understanding the challenges of IoT integration for the workforce in facilities management. After collecting data, the summary of responses regarding organizational resistance, skill gaps, data security concerns, and job displacement is presented in Table 10.

Table 10 *Challenges of IoT Integration for the Workforce*

Challenge Dimension	Mean Score	Interpretation
1. Organization Resistance to Change	4.24	High
• Staff fear losing jobs to IoT.	4.25	High
• Poor communication slows adoption	4.34	High
• Old systems make change harder	4.12	High
2. Skill Gaps and Training Needs in FM	4.20	High
• Staff lack digital knowledge.	4.18	High
• Limited training for staff	4.32	High
• Budgets stop upskilling	4.09	High

3. Data Security and Privacy Concerns	4.14	High
• IoT increases hacking risks.	4.11	High
• Weak protection exposes data.	4.14	High
• Hard to follow privacy rules.	4.18	High
4. Job Displacement and Role Redefinition	4.45	High
• IoT reduces manual jobs.	4.51	High
• Roles must be redefined.	4.41	High
• Staff worry about job security.	4.42	High

As shown in Table 10, job displacement and role redefinition emerged as the most critical challenge (mean = 4.45). This indicates strong concern among FM employees regarding job security and the reduction of manual roles due to automation. Such concerns may contribute to resistance and anxiety during digital transformation.

Organisational resistance to change ranked second (mean = 4.24), highlighting issues such as poor communication and reliance on outdated systems. Skill gaps and limited training opportunities also present significant challenges, reinforcing the need for structured workforce development. Although data security and privacy concerns recorded the lowest mean score among the challenges, they remain highly significant, reflecting growing awareness of cybersecurity risks associated with IoT systems.

4.4 Strategies for Managing Workforce Transitions in Facilities Management

Objective 3: To recommend strategies for managing workforce transitions in response to IoT integration in FM.

Part D questions focused on understanding strategies for managing workforce transitions in facilities management. After collecting data, the summary of responses regarding workforce readiness, targeted training, and cross-functional collaboration is presented in Table 11.

Table 11: Strategies for Managing Workforce Transitions

Strategies	Mean Score	Interpretation
1. Practical training is essential for the IoT transition	4.20	High
2. Conduct upskilling programs to improve workers knowledge about IoT.	4.29	High
3. Collaboration between FM, IT, and HR teams improves IoT adoption.	4.19	High
4. Clear communication from management helps employees adapt to IoT tools.	4.29	High
5. Rewarding staff who learn new digital skills encourages IoT adoption.	4.19	High
6. Assessing employees' current skills helps prepare for IoT adoption.	4.19	High

Table 11 indicates that upskilling programmes and clear communication from management are the most effective strategies for managing workforce transitions during IoT adoption with mean value of 4.29 for both strategies. These findings highlight the importance of equipping FM employees with relevant digital skills while ensuring transparency throughout the transformation process. Practical training and cross-department collaboration further support smoother transitions by enabling employees to adapt confidently to new technologies with mean value of 4.20. Incentives and skills assessment also play supportive roles in encouraging continuous learning and workforce readiness (mean value 4.19).

4.5 Discussion

For Objective 1, the findings revealed that IoT adoption had a substantial impact on workforce dynamics among FM employees, with workforce efficiency and productivity recording the highest mean (4.19). Respondents indicated that IoT significantly reduced manual tasks, prevented system failures, and enabled remote monitoring. These results are consistent with previous studies showing that IoT improves operational efficiency, facilitates predictive maintenance, and enhances real-time decision-making in facilities management (Whitmore *et al.,* 2015; Boyes *et al.,* 2018; Fernandez *et al.,* 2021). Additionally, the shift in skill requirements supports prior research highlighting those digital technologies demand greater digital literacy and cross-functional collaboration among FM employees (Codinhoto *et al.,* 2023; Dahanayake & Sumanarathna, 2022).

Regarding Objective 2, the most prominent challenge identified was job displacement and role redefinition (mean=4.45), reflecting employee concerns over automation and changing responsibilities. Organisational resistance, skill gaps, and cybersecurity risks also scored highly, indicating that human and structural factors remain critical during digital transformation. These findings align with earlier studies suggesting that workforce anxiety, lack of management support, and insufficient training are common barriers to IoT implementation in FM (McKinsey & Company, 2021; Laumer et al., 2016; Wiese *et al.,* 2024). Although data security concerns were slightly lower, they still highlight the growing importance of cybersecurity awareness among employees (ISACA, 2019; Boyes *et al*., 2018).

For Objective 3, strategies to support workforce adaptation were strongly endorsed, with upskilling programmes and clear communication from management recording the highest mean (4.29). Participants emphasized the value of structured training, cross-department collaboration, and ongoing skills assessment in successfully navigating IoT-driven change. These findings reinforce prior recommendations that integrating technical solutions with workforce development and leadership engagement is essential for achieving smooth digital transitions and improving employee confidence in FM operations (Deloitte, 2020; World Economic Forum, 2021; Hassanain *et al.,* 2024). Overall, the study demonstrates that while IoT provides operational advantages, careful attention to workforce readiness and organisational support is crucial for sustainable implementation.

5. Conclusion

The findings of this study confirm that all research objectives were successfully achieved. Objective 1 was met by demonstrating that IoT adoption significantly improves workforce efficiency, productivity, and decision-making among FM employees through automation, predictive maintenance, and remote monitoring, while simultaneously increasing the demand for digital literacy and cross-functional collaboration. Objective 2 was achieved by identifying key challenges associated with IoT-driven digital transformation, with job displacement and role redefinition emerging as the most prominent concerns, alongside organisational resistance, skill gaps, and cybersecurity risks. Objective 3 was also fulfilled, as the study highlighted effective strategies to support workforce adaptation, particularly upskilling programmes, clear management communication, and continuous skills assessment, which were strongly endorsed by respondents. Overall, the study underscores that although IoT offers substantial operational benefits in facilities management, its sustainable implementation depends largely on human-centred approaches that prioritise workforce readiness, organisational support, and ongoing employee development alongside technological advancement.

Acknowledgement

This research was conducted as part of the academic requirements of Universiti Tun Hussein Onn Malaysia (UTHM). The author would like to express sincere appreciation to the supervisor and faculty members for their guidance, support, and valuable feedback throughout the completion of this study.

Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design****: Tarani A/P Palanisamy, Norliana binti Sarpin;* ***data collection****: Tarani A/P Palanisamy****; analysis and interpretation of results****: Tarani A/P Palanisamy, Norliana binti Sarpin;* ***draft manuscript preparation****: Tarani A/P*

Palanisamy, Norliana binti Sarpin, Roshartini binti Omar, Aina Mardia binti Sallehuddin, Haryati binti Shafii, Goh Kai Chen. All authors reviewed the results and approved the final version of the manuscript.

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