International Journal of Management, Finance and Accounting

Internet of Things Adoption by Organisation: A Systematic Review

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Abstract

Despite the transformative potential of the Internet of Things (IoT) and Industry 4.0, adoption of IoT technologies remains slow and limited in organisations. This study addresses this challenge by conducting a systematic review to identify key factors influencing IoT adoption from the organisation level and social science perspective. Using the PRISMA protocol, a total of 16 empirical articles published between 2016 and 2024 were selected from Scopus and Web of Science databases. A deductive thematic analysis guided by the Technology-Organisation-Environment (TOE) framework revealed that relative advantage, organisational readiness, and competitive pressure were the most frequently cited determinants of adoption. Meanwhile, trust, awareness of IoT, leadership characteristics and government support were identified as underexplored variables. The findings provide theoretical contributions by refining adoption models and offer practical insights for policymakers and practitioners seeking to accelerate the implementation of IoT. Future research is recommended to apply qualitative designs and expand search strategies to include expert-verified keywords and alternative databases.

Keywords: Industry 4.0, Adoption Factors, Internet of Things (IoT), Organisation, Technology Adoption.

International Journal of Management, Finance and Accounting
Vol. 6, Issue 2 (2025) https://doi.org/10.33093/ijomfa.2025.6.2.11

Published by MMU PRESS. URL https://journals.mmupress.com/ijomfa

Received on 28 March 2025; Accepted on 29 May 2025; Published on 30 August 2025

To cite this article: Jamalut, Y., Rahim, M. F. A., & Ong, J. W. (2025). Internet of Things (IoT) adoption by organisation: A systematic review. *International Journal of Management, Finance and Accounting, 6*(2), 300-340. https://doi.org/10.33093/ijomfa.2025.6.2.11

1.0 Introduction

In the era of Industry 4.0, the Internet of Things (IoT) stands as a game-changing technology that holds the potential to revolutionise organisational processes and business models. The Internet of Things refers to a network of interconnected objects that communicate with each other and other Internet-enabled devices via the Internet (Ben-Daya et al., 2019). This technology enables remote monitoring and control of the physical world, thereby offering organisations a wide range of benefits (Rejeb et al., 2022). This creates multiple opportunities for organisations to enhance operational efficiency and improve customer experiences. By 2025, it is expected that there will be 24 billion connected IoT devices (GSMA Intelligence, 2021). These could contribute USD 5.5 to 12.6 trillion to the global economy by 2030, benefiting both consumers and businesses (Chui et al., 2021). However, IoT adoption remains slow and limited across various organisations (Brous et al., 2020; Luthra et al., 2018; Tripathi & Pandit, 2019; Padyab et al., 2019). This indicates the need for thorough research to better understand what influences organisations' decisions to adopt IoT. A systematic review was conducted in this research to provide a comprehensive and unbiased analysis of all relevant studies on a particular topic, thereby generating a robust, evidence-based answer to a specific research question (Petrosino et al., 2001). This can allow for a more accurate evaluation of the factors influencing IoT adoption in organisations. Several systematic reviews on IoT adoption studies at the organisational level have been conducted worldwide. For example, in the food supply chain (Aamer et al., 2021), healthcare (AlMansour & Saeed, 2019), oil and gas (Wanasinghe et al., 2020), supply chain management (Birkel & Hartmann, 2019), and the halal food supply chain (Rejeb et al., 2022).

All these studies are sector-specific, and their findings cannot be generalised; the researchers are often confined to the sector under study. Only a few studies, such as those by Brous et al. (2020), Carcary et al. (2018), and Lu et al. (2018), have taken a broader view, examining IoT adoption by organisations without narrowing in on a specific sector. This approach would enable a better understanding of the common challenges and opportunities associated with IoT adoption, facilitating the sharing of successful practices across different sectors and ultimately improving overall IoT adoption. Therefore, there is a need to understand the general factors that influence IoT adoption across all

organisations, not just within specific industries. Moreover, Leong et al. (2021) and Lu et al. (2018) found that only a few previous studies related to IoT adoption focus on the context of social sciences. Most of the available literature primarily focuses on the technical and application aspects of IoT technology in specific sectors (Adli et al., 2023; Alex et al., 2023; Pagano et al., 2022; Sasirekha et al., 2023; Meydani et al., 2023). While the technical aspects of IoT adoption are crucial, a comprehensive understanding also requires consideration of social science perspectives from human, organisational, societal, regulatory, and cultural factors. Due to these reasons, the social sciences perspective is crucial in IoT adoption, as highlighted by previous studies (Ali et al., 2020; Bulut & Wu, 2024; Carcary et al., 2018; Mähler, 2020).

There were previous studies discussing IoT on individual level (Abushakra & Nikbin, 2019; Alarefi, 2023; Alkawsi & Baashar, 2020; Almugari et al., 2020; Arfi et al., 2021; Çolak & Kağnicioğlu, 2021; Chatterjee, 2020; Chen & Zhang, 2019; Kao et al., 2019; Khanna & Kaur, 2023; Nawi et al., 2021; Pillai & Sivathanu, 2020; Ronaghi & Forouharfar, 2020; Shi et al., 2022; Tsourela & Nerantzaki, 2020) and organisational level (Ben-Daya et al., 2019; Masmali & Miah, 2019; Parra et al., 2021; Pappas et al., 2021; Singh et al., 2020). Based on the study by Leong et al. (2021), there is still a minimal amount of research on IoT adoption at the organisational level. This lack of focus has left a gap in understanding how organisations interact with and adopt IoT technologies. It is essential to study IoT adoption at the organisational level because different motivations and considerations often drive organisations' decisions to adopt such technologies compared to individuals. Additionally, a generalised study at the organisational level can have broader societal implications, influencing industry standards and practices and shaping market dynamics.

While existing literature has explored IoT adoption in specific domains such as healthcare, oil and gas, and supply chain, few studies have examined the phenomenon across organisations from a cross-sectoral social science perspective. Moreover, important non-technical factors such as leadership characteristics, trust, and institutional support remain underexplored within the TOE framework. This study addresses this gap by conducting a systematic review to identify and analyse key determinants influencing IoT adoption from the lens of technological, organisational, and environmental perspectives.

This study aims to identify common adoption factors across sectors, uncover less-studied yet impactful variables, and provide actionable recommendations for researchers, policymakers, and practitioners.

2.0 Methodology

This section outlines the three main subsections employed in the current research: PRISMA, resources, and the systematic review process (identification, screening, and eligibility).

2.1 The Review Protocol (PRISMA)

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure rigour and transparency. Developed by Page et al. (2021), PRISMA is not only suitable for medical studies but also applicable in the field of management (Shaffril et al., 2019). It offers three key benefits: defining clear research questions for systematic investigation, establishing inclusion and exclusion criteria, and enabling the examination of an extensive database of scientific literature within a defined timeframe (Sierra-Correa & Kintz, 2015). By utilising PRISMA, the researcher was able to perform an extensive search on terms related to organisational IoT adoption, which enabled the identification of factors influencing this adoption process.

2.2 Resources

The study utilised two databases, namely Web of Science (WoS) and Scopus. The success of a systematic literature review largely depends on the quality and breadth of the databases used. Selected for their extensive coverage of high-quality, peer-reviewed publications in various disciplines, WoS and Scopus offer expansive repositories. WoS covers more than 256 fields of study with 33,000 journal articles, including subjects related to technology and innovation management. On the other hand, Scopus spans 240 disciplines and indexes

22,800 journals globally, encompassing areas pertinent to technology management. By leveraging these two robust databases, this study ensures an exhaustive and comprehensive review of the existing literature within the field, thereby maximising the potential to extract valuable insights and contribute to the study's overall credibility and impact.

2.3 Systematic Review Process

2.3.1 Identification

During the first phase of the systematic review, the researcher strategically selected a combination of keywords to ensure comprehensive coverage of the topic. This selection was guided by previously used keywords in similar studies, an online thesaurus, and Scopus-suggested keywords. Furthermore, the keywords were also developed in accordance with the research question, as recommended by Okoli (2015). These keywords included 'Factors,' 'Internet of Things (IoT)', 'adopt', and 'organisation'. Next, both Boolean operators and truncation were used on the database to enrich the current keywords and produce the full search string. The search string is customised according to the search system in each database to ensure optimal results and to meet the research objectives. Accordingly, search strings for the selected databases were developed in January 2024, as shown in Table 1. This identification process retrieved 50 articles from Web of Science (WoS) and 40 articles from Scopus, totalling 90 identified articles.

2.3.2 Screening

In the screening stage, 90 articles were screened based on several inclusion and exclusion criteria determined by the researcher, focusing on the timeline, type of literature, language, and research scope, as shown in Table 2. The selected timeline was from 2016 to 2024. Due to the considerable number of articles, it was essential to set a timeline for review, following Okoli (2015), which states that writers should determine the time range of the articles before reviewing them. An initial search by the researcher on the selected databases revealed a limited number of studies on IoT adoption prior to 2016. Additionally,

Ahmetoglu et al. (2022) have conducted systematic reviews focusing on the years post-2016.

Given the relatively recent emergence and growth of IoT technology, an eight-year range was deemed sufficient for a comprehensive review, aligning with Kraus et al. (2020) suggestion about research maturity in nascent fields. Therefore, the selected timeline of 2016 to 2024 became a crucial inclusion criterion. For the type of literature, the researcher chose to concentrate solely on journals as they typically provide empirical data crucial for achieving the research objective. This decision led to the exclusion of systematic reviews, books and book chapters. Furthermore, only articles published in English were included to avoid potential language-based misunderstandings. This inclusion and exclusion process resulted in the exclusion of 10 articles, leaving 80 articles. The next step was to remove duplicate articles. In this case, a total of 10 duplicate papers were thoroughly identified by the researcher using the sorting method in Microsoft Excel and were excluded, resulting in 70 articles.

Table 1: Search String used for the Systematic Review Process

Database	Keyword Used
Web of Science	TS= (Factors OR Predictors OR Determinant) AND ("Internet of thing" OR IoT) AND (adopt OR accept OR diffuse) AND (organisation*)
Scopus	TITLE-ABS-KEY ((*factors* OR *predictors* OR determinants) AND ("*Internet of things*" OR *iot*) AND (*adopt* OR *accept* OR *diffuse*) AND) (*organisation**))

Table 2: Inclusion and Exclusion Criteria for this Study

Criterion	Inclusion	Exclusion
Timeline	Between 2016 to December 2024	< 2016
Literature Type	Journal	Systematic review, review, books, chapters in a book, technical articles, and periodical articles
Language	English	Non-English
Scope	All subject areas	

2.3.3 Eligibility

The eligibility phase in the PRISMA protocol is the third stage and involves a thorough evaluation of the full-text articles that were deemed potential. This step ensures that the studies chosen for the final review are not only relevant to the research question but also meet all the specified inclusion criteria. At this stage, a total of 70 articles were thoroughly examined based on their titles, abstracts, and main contents, and only studies related to IoT technology from an organisational perspective were included. As a result, 57 articles were excluded, and a total of 16 articles were ready for examination. Although 90 articles were initially identified, many were excluded due to insufficient focus on organisational-level IoT adoption, lack of empirical findings or failure to align with the inclusion criteria. After full-text screening, only 16 articles were identified as both relevant and methodologically rigorous for inclusion in the final analysis. The flow diagram of the systematic review is shown in Figure 1.

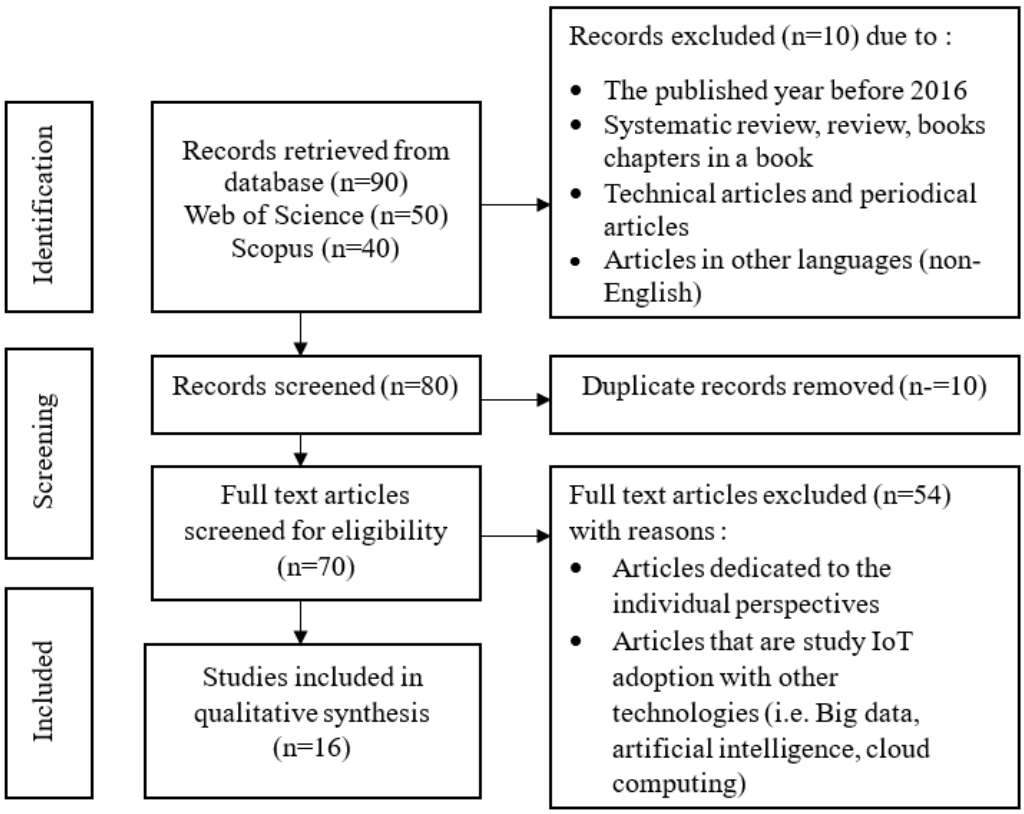

Figure 1: Flow Diagram of the Study

3.0 Results and Discussion

This section presents the results of data abstraction and analysis and consolidated analysis, including technological, organisational, and environmental factors.

3.1 Data Abstraction and Analysis

The selected articles were analysed using a deductive approach guided by a research question, which aims to identify the factors influencing IoT adoption in organisations. Firstly, relevant data was extracted from the empirical studies included in this review and compiled into a matrix table (Table 3). The method of identifying the factors is adopted from the studies by Qasem et al. (2019) and Ahmetoglu et al. (2022). This table consists of five columns: author, organisation type, theory, dependent variables, and independent variables. These variables were then classified according to specific factors, as detailed in Table 4. To identify the influencing factors, the deductive process followed several steps:

i. Variables identified in Table 3 were extracted and grouped.

ii. Within each group, variables were filtered to eliminate duplication, as some studies used similar variables under different names.

iii. Variables specific to certain industries were removed to ensure the applicability of all variables across diverse organisations.

iv. Each group was assigned a factor name based on the common characteristics of the variables within the group, as summarised in Table 4.

Thematic groupings in Table 4 were derived through a frequency-based deductive analysis, and factors mentioned in three or more studies were considered dominant. Similar variables were grouped and renamed based on conceptual similarity, using prior literature (Qasem et al., 2019) and guidance from Ahmetoglu et al. (2022).

Table 3: Empirical Studies Examining the IoT Adoption Factors in Organisations

Author	Organisation Type	Theory	Dependent Variable	Independent Variables
Chen and Zhang (2019)	Hotel sector /Hospitality	-	IoT smart hotel adoption	**Innovative perception** Relative benefits, complexity, cost **Internal organisation** Support executive organisational size
Cranmer et al. (2022)	Micro, Small and Medium Enterprises (MSMEs)	-	IoT adoption	**External organisation** Competitive pressure, awareness of IoT, access to information collaboration with sources, communication, competitive advantage lack of knowledge, business strategy, security and privacy issues, high investment costs, lack of standardisation, unstructured and complex ecosystem
Das (2022)	Public sector retail oil outlets	TOE	IoT adoption	**Technology factors** Quicker decision, automation, efficient cashless activities, process automation, provider of IT services, wearable devices, sensors, prudent use of assets **Organisational factors** Brand equity, workers, financial benefits, reduced cost, new source of revenue **Environment factors**

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Author	Organisation Type	Theory	Dependent Variable	Independent Variables
				Bonding with consumers, marketing value, advantage over competitors, user experience, linking of consumer mobile to outlet sensors, comfort. consumer hope, higher sales in stores, consumer information **Data security** Safeguarding data, security hazard
Hawash et al. (2021)	Oil and Gas	TOE	IoT adoption	**Technological factors** Technology infrastructure, use of technology resources **Organisational factors** Top management support, scope of business operation **Environment factors** Competitive pressure, governmental policy **Security factors** Information security, corporation security
Infante-Moro et al. (2021)	Hotel sector /Hospitality	TOES	IoT adoption	**Technological** Complexity, compatibility, relative advantage, perceived cost **Organisational** Characteristic of the leader or manager, perceived reliability of the technology, top management support, size of the

Author	Organisation Type	Theory	Dependent Variable	Independent Variables
				company, technological organisational readiness **Environmental** Pressure from competitors, Business partner pressure, customer pressure, government pressure, support from information systems (IS) providers
Kusnandar et al. (2023)	Agriculture	Resource Based View	IoT adoption	**Technology anxiety** Not used to using IoT, ability to use IoT **Relative Advantage** Efficiency, business profit, value-added **Social Influence** Social environment, personal relationship **Alternative** IoT education for millennials, strengthening openness to change, optimisation of institutional roles, socialising the benefits of IoT to millennial farmers
Ladasi et al. (2019)	Agribusiness	TOE HOT-fit	IoT adoption intention	**Human Factors** Innovation of the leader, technical skill owned IT staff, technical skill owned non-IT staff, previous experience owned IT staff **Technological Factors**

Author	Organisation Type	Theory	Dependent Variable	Independent Variables
				Existing SI/IT infrastructure, security and data privacy, technological complexity, technological & organisational alignment **Organisational Factors** Centralised decision-making process, formalisation on task codification, size of organisation, expected relative profit adequate human resource, employee attitudes toward organisational changes, top, management support, perceived technological adoption costs **Environmental Factors** Vendor support, perceived mimetic pressure, perceived coercive pressure, external expert availability
Mukherjee et al. (2024)	Small and Medium Enterprises (MSMEs)	Dynamic capability view extends the resource-based	IoT adoption	**Technological** Relative advantage, infrastructure, compatibility, trust **Organisational** Top management support, organisational readiness, technical capability **Environmental** Competitive pressure, innovativeness **Human** Internal excellence, prior experience

Author	Organisation Type	Theory	Dependent Variable	Independent Variables
Rawashdeh et al. (2023)	Auditing firms / Financial Services	TOE and DOI	IoT adoption	**Organisational context** Top management support, absorptive capacity, preparedness for challenges **Mediator** Vision
Satar et al. (2019)	Oil and Gas	TOE- DOI-Oil & Gas Value OGV	IoT adoption Intention	**Technology & Innovation** Relative advantage, complexity compatibility, technology readiness, security concern **Organisation Factors** Top management support, firm size **Environment Factors** Competitive pressure, trading partner pressure, Information intensity, regulatory support **Industry Factors** Financial performance customer value, societal value, environmental value
Abd Shukor et al. (2022)	Bumiputera Small Medium Enterprises (SMEs)	TOE	IoT adoption	knowledge, awareness, organisation change, adhocracy, business transformation **Moderating** Age, gender, educational level, marital status
Sivathanu (2019)	Auto-Component Manufacturing (ACM) SMEs	TOE	IoT adoption intention	**Technological Factors** IoT expertise, IoT infrastructure, relative advantage, cost, compatibility, security and privacy

Author	Organisation Type	Theory	Dependent Variable	Independent Variables
				Organisational Factors Top management support, organisational readiness **Environment Factors** Competitive pressure, support from IoT vendors **Control variable**: Organisation size
Yu et al. (2022)	Supply Chain	-	IoT adoption	**Environmental factors** E-waste generation, use of harmful substances and non-degradable resources across their entire life cycle, high energy consumption **Economic factors** financial constraints / insufficient budget operational cost, extended payback period **Technological factors** Legacy of suppliers' IT infrastructure, lack of technological knowledge among partners **Organisational factor** Inability to experiment quickly, inadequate collaboration between IT and lines of business, employee pushback risk aversive culture, change management capabilities, lack of a corporate vision and no overarching strategy for digitalisation

Author	Organisation Type	Theory	Dependent Variable	Independent Variables
Bahari et al. (2024)	Agricultural organisation /	TOE	IoT adoption	**Technological factors** Relative advantage, Complexity, Compatibility, Technology competence, Cost **Organisational factors** Technical knowledge, Top management Support, Organisational readiness, Organisational size **Environmental factors** Competitive pressure, Government support, Information intensity
Scur et al. (2023)	Agriculture	TOE and UTAUT	Adoption of IoT	**Behavioural Factor** Performance expectancy, Social influence, Effort expectancy, Facilitating condition **Technological Factors** Costs, availability **Organisational Factor** Company size and structure **Environmental Factor** Competitive pressure, government
Opasvitayarux et al. (2022)	Food supply chain	TOE, DOI, TAM, UTAUT, PVC, TDC, STK, IST	IoT Adoption Intention	**Technological** Relative advantage, compatibility, complexity, trialability, observability, perceived risk, privacy concern **Organisational** Firm size, adaptive, absorptive, innovative capability

Author	Organisation Type	Theory	Dependent Variable	Independent Variables
				Environmental Executive support, competitive pressure, value chain partner pressure, social pressure, presence of the service providers, government support, trust, information sharing attitude **Mediator** Attitude towards adoption

Table 4: Factors that Influence the IoT Adoption in Organisation

Author(s)	TECHNOLOGICAL							ORGANISATIONAL					ENVIRONMENTAL		
	CX	CP	RA	SP	TT	AI	TM	OR	TR	CT	OS	CL	CP	GS	SV
Chen and Zhang (2019)	/		/				/			/	/		/		
Cranmer et al. (2022)						/		/	/	/			/	/	
Das (2022)			/					/					/		/
Hawash et al. (2021)				/			/		/		/		/	/	
Infante-Moro et al. (2021)	/	/	/		/		/		/	/	/	/	/		/
Kusnandar et al. (2023)			/			/	/	/					/		
Ladasi et al. (2019)	/	/	/	/			/	/		/	/		/		/
Mukherjee et al. (2024)		/	/		/		/	/	/				/		
Rawashdeh et al. (2023)							/	/				/			
Satar et al. (2019)	/	/	/	/			/		/		/		/	/	
Abd Shukor et al. (2022)						/		/							
Sivathanu (2019)		/	/	/					/	/			/		/
Yu et al. (2022)								/		/		/			/
Bahari et al. (2024)	/	/	/				/	/		/	/		/	/	
Scur et al. (2023)		/								/	/		/	/	
Opasvitayarux et al. (2022)	/	/	/		/						/		/	/	
Total	**6**	**8**	**10**	**4**	**3**	**3**	**9**	**9**	**6**	**8**	**8**	**3**	**13**	**6**	**5**

International Journal of Management, Finance and Accounting
Vol. 6, Issue 2 (2025) https://doi.org/10.33093/ijomfa.2025.6.2.11

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Notes:	**TECHNOLOGICAL**	**ORGANISATIONAL**	**ENVIRONMENTAL**
	CX = Complexity	**TM**= Top management support	**CP**= Competitive pressure
	CP= Compatibility	**OR**= Organisation readiness	**GS**=Government support
	RA= Relative advantage	**TR**=Technological readiness	**SV**=Support from IoT vendors
	SP=Security and Privacy	**CT**=Cost	
	TT=Trust	**OS**= Organisation size	
	AI=Awareness of IoT	**CL**=Characteristic of leader/manager	

3.2 Consolidated Analysis

Table 3 presents a collection of empirical studies examining the factors influencing the adoption of IoT technology across various organisational sectors. This table provides insights into the types of organisations, theories employed, and dependent and independent variables in each study. The adoption of IoT was studied across a diverse range of sectors, including the hospitality sector, micro, small, and medium enterprises (MSMEs), the oil and gas industry, the agriculture industry, financial services, manufacturing, and supply chains. This diversity suggests that IoT adoption is a subject of interest across various sectors. Across sectors, agriculture-focused studies (Bahari et al., 2024; Kusnandar et al., 2023) emphasised environmental pressures and technological readiness, while service sectors like hospitality (Chen & Zhang, 2019; Infante-Moro et al., 2021) and finance (Rawashdeh et al., 2023) highlighted cost, top management support, and security concerns. This suggests sectoral differences in adoption priorities.

Furthermore, several theories are employed to study IoT adoption. The most recurrent one is the Technological, Organisational, and Environmental (TOE) framework. Other theories employed include the Resource-Based View (RBV), the Dynamic Capability View, the Diffusion of Innovations (DOI), and the Technology-Organization-Environment (TOE) framework combined with DOI. The employment of these theories indicates that IoT adoption is being studied from multiple theoretical perspectives. In all studies, the dependent variable is either the adoption or the intention to adopt IoT technology. This consistency shows that the primary focus and objective is to understand the factors of the adoption of IoT technology within organisations. Moreover, in previous studies, independent variables were mostly categorised into technological, organisational, and environmental.

Although some previous researchers related to IoT adoption utilising TOE framework have addressed human factor (Ladasi et al., 2019; Mukherjee et al., 2024), security factor (Das, 2022; Hawash et al., 2021; Infante-Moro et al., 2021), industry (Satar et al., 2019), economic (Yu et al., 2022), behavioural (Scur et al., 2023), mediators (Opasvitayarux et al., 2022) and moderator (Abd Shukor et al., 2022) as separate categories, the researcher chose to align with the TOE framework's approach,

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incorporating these elements under technological and organisational and environmental dimensions. This is primarily due to the practicality, clarity, and comprehensiveness of this TOE framework.

From the analysis of 16 selected studies, a total of 15 adoption factors were identified and grouped into three categories: Technological, Organisational, and Environmental, as shown in Table 4. This insight is also in line with the Technological, Organisational, and Environmental (TOE) framework by Tornatzky and Fleischer (1990) and Tornatzky and Klein (1982), which is a widely accepted theoretical model for understanding and predicting the adoption of new technologies within organisations. Among these, relative advantage (10 studies), organisational readiness (9 studies), and competitive pressure (13 studies) were the most frequently cited factors. Conversely, trust, awareness of IoT, government support, and leadership characteristics appeared in fewer than 5 studies, indicating underrepresentation. This frequency pattern supports the identification of key drivers and research gaps, aligning with the study's objective to highlight both prominent and underexplored factors, as shown in Figure 2.

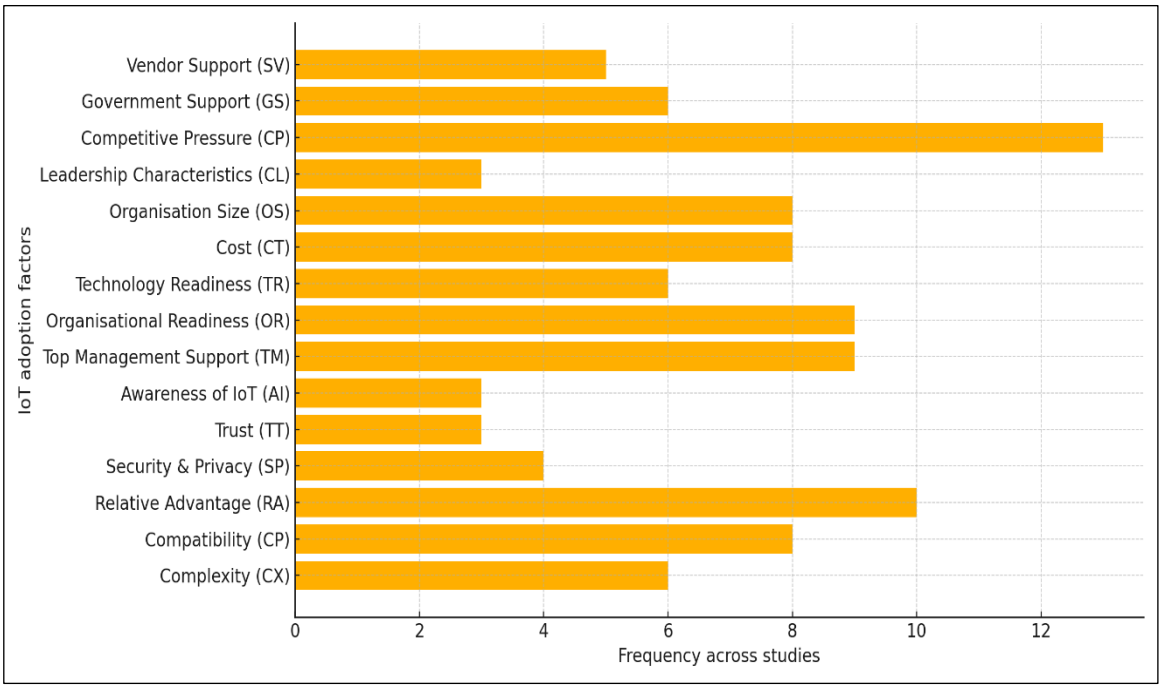

Figure 2: Frequency of IoT Adoption Factors in Reviewed Studies

3.2.1 Technological Factors

Previous researchers discussed six sub-factors based on technological factors. Complexity, compatibility, relative advantage, security and privacy, trust, and awareness of the Internet of Things (IoT) are all key technological factors that influence the adoption of IoT. The complexity of the technology and its compatibility with existing systems are consistently addressed as significant factors. These factors underscore the inherent challenges of integrating new technologies into established infrastructures. Additionally, the relative advantage of the technology, a measure of perceived value or improvement over existing systems, also influences adoption decisions and is highlighted by almost all researchers in this study. Security, privacy, and trust are other interconnected factors that emerge from several sources. As IoT devices handle vast amounts of potentially sensitive data, organisations must trust in the security of these devices. Awareness of the IoT is also a key factor in IoT adoption. The findings imply that the technological factors influencing the adoption of IoT technologies are complicated process involving not only the functional attributes of the technology but also the perceived benefits and risks. Relative advantage is the most significant factor discussed by previous researchers, and trust is the least discussed.

3.2.2 Organisational Factors

Based on organisational factors, six sub-factors were discussed, as per the previous literature. The factors were top management support, organisational readiness, technology readiness, cost, and characteristics of the leader/manager. Most previous researchers see top management support as a significant enabler of IoT adoption, as it influences the allocation of necessary resources and aids in overcoming resistance to change. Meanwhile, organisational readiness and technological readiness are crucial for adopting complex technologies like IoT, as organisations need the proper infrastructural capabilities to leverage these technologies. Furthermore, the cost of IoT technology adoption is a significant concern for organisations and often influences their decision-making process, from purchasing the necessary hardware and software to ongoing costs. Next, the size of the organisation can imply the resources available, the complexity of the decision-making

process, and the ability to absorb changes in operational processes. Furthermore, the characteristics of leaders or managers can play a vital role in shaping the adoption process, as their attitudes and competencies can either facilitate or inhibit technological innovation. The findings suggest that organisational factors play a crucial role in the decision-making process, with top management support and organisational readiness being the most significant factors discussed by previous researchers, while the characteristics of leaders or managers are the least discussed.

3.2.3 Environmental Factors

Environmental factors reveal the influence of external pressures and support on IoT adoption. The factors were competitive pressure, government support and support from IoT vendors. Competitive pressure is the most significant factor highlighted by previous researchers in this study that can drive organisations to adopt IoT to maintain or enhance their market position. Government support, in the form of regulations, incentives, or frameworks, can also promote IoT adoption by mitigating associated risks and costs. Lastly, support from IoT vendors can facilitate adoption by providing technical assistance and customisation. The findings indicate that environmental factors were important for IoT adoption, and competitive pressure was the most discussed factor by previous researchers, while government support was the least discussed.

4.0 Discussion

Based on this systematic review, it is revealed that certain factors within each of the TOE framework's dimensions receive more attention in the discourse around IoT adoption. Within the technological factors, relative advantage is a prominent discussion point in the literature. In the context of organisational factors, organisational readiness emerged as a key focal point, and within environmental factors, competitive pressure was highlighted as a significant influence on the adoption of IoT.

Relative advantage, a measure of perceived improvement or value over existing systems, is a crucial factor as it relates directly to the benefits an organisation might gain from adopting IoT technologies. These advantages could include improved operational

efficiency, enhanced service delivery, increased data collection and analytics capabilities, or simply the ability to innovate and offer novel services or products (Liu & Cao, 2022; Pillai & Sivathanu, 2020). As a result, when the advantages are evident and significant, organisations are more likely to consider adopting the technology. This insight aligns with prior findings by Narwane et al. (2019), who demonstrated a positive influence of relative advantage on the adoption of the IoT by Indian small and medium-sized enterprises. Likewise, Chandra and Kumar (2018) emphasised the significant role of relative advantage in influencing an organisation's intention to adopt augmented reality for e-commerce. Similarly, Arnold and Voigt (2019) disclosed the positive correlation between relative advantage and the adoption of Industrial IoT by German manufacturing companies. Thus, these studies underscore the importance of relative advantage as a significant factor in the adoption of innovative technologies, a factor that previous researchers have mostly discussed.

Organisational readiness indicates an organisation's capacity to absorb and implement IoT technologies. It is not only about having the necessary financial resources but also involves aspects such as technical infrastructure, employee skills, and a culture of innovation (Abd El-Hamed et al., 2021; Lokuge et al., 2019; Ramos et al., 2021). If an organisation is not ready to incorporate new technology, the implementation may fail or not yield the expected benefits, leading to wasted resources. Therefore, a high degree of organisational readiness is necessary to maximise the chances of successful IoT adoption. These results align with the findings of Muhamad et al. (2021), who explored the influence of organisational readiness on the adoption of Industry 4.0 by small and medium-sized Enterprises (SMEs) in Malaysia. Similar observations were reported in studies by Zaidi and Belal (2019), which focused on IoT readiness among Malaysian SMEs, and Ramos et al. (2021), who assessed the readiness of Philippine manufacturing SMEs to adopt IoT technology. Thus, it is evident that organisational readiness is a recurring theme in the discourse on IoT adoption within the organisational context, highlighting its importance in the overall process.

Moreover, competitive pressure represents the drive to maintain or enhance market position. As highlighted by Sam and Chatwin (2018), this external drive to remain competitive can play a substantial role in driving technology adoption, with the IoT being

no exception. The fear of lagging behind competitors who have successfully harnessed IoT can prompt organisations to adopt the technology, even if they encounter obstacles along the way. A study by Abed (2020) supports this viewpoint, suggesting that competitive pressure significantly influences the adoption of social commerce. Contrarily, a study by Yoon et al. (2020) found no significant impact of competitive pressure on the adoption of smart farms. These contradictory findings in different innovation technologies emphasise the importance of examining the role of competitive pressure in the organisational adoption of IoT technology to shed light on its influence on this technology.

In contrast to the high attention afforded to certain factors, this study reveals a comparatively subdued focus on others. Trust and awareness of the IoT have not been extensively examined within the technological context. Similarly, in the organisational context, the characteristics of a leader or manager have received less attention. Moreover, from an environmental standpoint, government support seems to be underrepresented in discussions. Trust in IoT systems is vital as it governs the willingness to rely on the technology. It encompasses confidence in the security measures embedded in these devices, assurance that data privacy standards are met, and belief in the IoT provider's commitment to ethical data handling. Trust is a study at the individual level, as seen in studies such as those by AlHogail (2018), Herzallah and Mukhtar (2016), and Jayashankar et al. (2018). It is also important to study trust at the organisational level. These dimensions of trust are crucial, as any breach can lead to substantial financial and reputational harm. Studying trust at the organisational level can provide an understanding of specific measures that enhance trustworthiness and indicate how organisations might build stronger trust networks with their IoT providers. Previous research, including studies by Tee and Wong (2019), Ma (2021), and Akinwunmi et al. (2015), highlights the significant impact of trust on the adoption of various technologies, such as e-business, internet pharmacies, and cloud technology, among SMEs and non-adopters.

Considering the unique characteristics of IoT technology that are distinct from these other technologies, it is valuable to explore this variable further. On the other hand, awareness of IoT as studied by Koohang et al. (2022), is crucial in understanding its potential benefits to organisations. It encompasses a broad understanding of IoT's potential, including its benefits and risks. Organisations should not only be aware of how

IoT can streamline operations and improve efficiency but also how it can expose them to cybersecurity threats and privacy issues. Moreover, organisations need to understand how IoT fits into their industry's larger context, such as evolving regulations and consumer expectations. Evidence of the impact of awareness comes from Silverio-Fernandez et al. (2019), who found that technological awareness has a significant effect on the adoption of smart devices in the construction industry. Similarly, Bhattacharyya and Shah (2022) concluded that a lack of managerial awareness hindered the adoption of emerging technologies in the Indian mining industry. Additionally, Jones and Graham (2018) confirmed that many SMEs businesses had little or no awareness of what IoT technologies were or the potential benefits they could deliver. These findings underscore the importance of exploring awareness as a crucial variable in the adoption of IoT technologies.

Next, the characteristics of a leader or manager extend beyond mere decision-making; they are also instrumental in shaping organisational culture and attitudes towards technological innovation (Baharuden et al., 2019; Giotopoulos et al., 2017). Leaders influence whether their organisation perceives IoT adoption as an opportunity or a threat and whether they prioritise investments in IoT. For instance, Yosua et al. (2019) demonstrated that the role of leaders in hastening the diffusion of innovations among farmers yielded positive results. This result highlights the importance of examining the influence of leadership characteristics on IoT adoption within organisations. Furthermore, government support often acts as an external motivation for organisations to adopt new technologies. This support can be explicit, in the form of subsidies, tax incentives, or beneficial regulations, or implicit through the development of IoT standards, public infrastructure, or initiatives that promote digital transformation. Affia et al. (2019) and Hawash et al. (2021) have indicated that government support can lead to higher IoT adoption among organisations.

However, studies by Chong et al.(2021) and Lin et al. (2016) suggest that the impact of government support on technology adoption can vary depending on the organisation's size. Similarly, Gui et al. (2020) found that government support did not significantly influence the adoption of cloud computing among micro, small, and medium-sized enterprises (MSMEs) in Indonesia. These mixed findings underscore the need for further investigation into this factor in the context of IoT adoption.

5.0 Conclusion and Future Research

In conclusion, this review of previous studies on IoT adoption among organisations highlights the factors influencing its adoption. The review identifies technological, organisational, and environmental factors as critical in shaping the adoption of the IoT. Additionally, several studies have expanded the traditional TOE framework to include human, security, industry, economic and behavioural factors. However, the researcher decided to restrict the analysis to the TOE framework, as it is a complete and robust framework. This review identified 15 factors for technology adoption, such as relative advantage, organisational readiness, and competitive pressure, as the most significant factors influencing IoT adoption by organisations. Furthermore, trust, awareness of IoT, the characteristics of leaders or managers, and government support were factors that need further exploration.

The review suggests several recommendations for future studies. First, more focus is needed on less-researched factors and inconsistencies identified by past researchers, such as trust, awareness of IoT, characteristics of leaders, and government support. Second, future research should explore qualitative approaches or mixed methods to gain richer insights into decision-making dynamics. Such methods can provide in-depth explanations of organisational attitudes, contextual factors, and behavioural patterns influencing IoT adoption. Third, more search keyword combinations can be conducted to obtain more high-quality articles. Fourth, it is recommended for future researchers to consult experts in the fields of IoT technology and technology management to develop an enhanced range of search keywords. Such collaborations would facilitate the construction of more precise and targeted search strings, ensuring the retrieval of high-quality articles that make meaningful contributions to the body of knowledge. Fifth, future reviews should consider broader databases beyond WoS and Scopus. Although the initial selection of 90 articles was based on abstract reading, some were found to be irrelevant upon more in-depth examination. Incorporating books, book chapters, and industry reports can further enhance the diversity and depth of the knowledge base.

5.1 Research Contribution

The findings of this review offer valuable insights for decision-makers, policymakers, developers, and the community, allowing them to design effective strategies to expedite IoT adoption within their organisations. Thus, this review makes a significant contribution to the body of knowledge on IoT adoption, offering several recommendations that can inform future research on this topic. For practitioners and policymakers, the findings offer guidance to prioritise interventions that strengthen organisational readiness and address market pressures. This includes investing in infrastructure, leadership training, and vendor partnerships. Theoretically, the study expands the TOE framework by reinforcing the need to incorporate social and behavioral dimensions, such as trust and leadership attributes, within adoption models.

Author Contributions Statement: All authors collaborated on this paper. Conceptualisation: Y.J; Methodology: Y.J; Formal analysis and investigation: Y.J; Writing - original draft preparation: Y.J; Writing - review and editing: Y.J, M.F.A.R. Supervision: M.F.A.R & O.J.W. All authors have reviewed and approved the final version of the manuscript.

Funding Statement: This project is supported by the Fundamental Research Grant Scheme (FRGS), FRGS/1/2021/SS01/MMU/02/5 and FRGS/1/2021/SS01/MMU/02/2. The authors extend their gratitude to the Ministry of Higher Education, Malaysia, for their support.

Informed Consent Statement: Informed consent was obtained from all participants involved in this study.

Data Availability Statement: The data are available from the corresponding author upon reasonable request.

Acknowledgement: The authors extend their gratitude to all the respondents who participated in this study, as well as to the editors and anonymous reviewers of the *International Journal of Management, Finance and Accounting* for their valuable feedback and comments.

Conflict of Interest Statement: The authors declare no competing interests related to the content of this study.

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