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Adoption of Internet of Things: A systematic literature review and future research agenda

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ABSTRACT

The Internet of Things (IoT) is one of the promising technologies in industry 4.0, which has the potential to provide a myriad of advantages and offer convenience to individuals' daily lives and efficiency to businesses. Due to the enormous potential of the Internet of things, attention towards its adoption is increasing significantly. Despite the undeniable relevance of this field, the current study aims to synthesize the body of knowledge on IoT adoption using systematic literature review (SPAR-4-SLR) with the TCCM framework. 101 articles were carefully selected after a thorough search in the Web of Science and Scopus databases. This study has performed an in-depth descriptive analysis to present the current state of knowledge. The findings of this study revealed that the Technology acceptance model and Unified theory of acceptance and use of technology were the most widely employed theories and models in previous literature. Furthermore, this study has developed an integrative conceptual framework including antecedents, mediators, moderators, and outcomes. Also, the antecedents are classified into four categories based on the Technology-organization-environment framework with end user-specific category. By integrating the existing knowledge, the study identifies significant gaps and offers a fertile ground for further investigation in this field.

Keywords: Internet of things, IoT, Adoption, SPAR-4-SLR, TCCM

INTRODUCTION

The rapid development of innovative technologies has led to social and economic transformation (Strong et al., 2022), which has sparked the beginning of the fourth industrial revolution. "Industry 4.0" is evolved due to the emergence of various revolutionary technologies, including Internet of Things (IoT) (Hsu and Yeh, 2017), machine learning (Park and Jeong, 2021), blockchain (Kuberkar and Singhal, 2021), artificial intelligence (Arfi et al., 2021), and digital twins (Umair et al., 2021). The introduction of these technologies prompted new ways of providing services that disrupted conventional methods. Organisations from different industries have implemented these technologies into their business models to gain a competitive edge and survive in the market (Bhatt and Chakraborty, 2020). For instance: Healthcare industry has employed IoT devices to track the real-time location of hospital equipment and communicate with their patients offsite through viable data collection and management (Liu et al., 2022; Umair et al., 2021), agriculture sector used IoT sensors to collect machine metrics and environmental data (Ayaz et al., 2019; Raj et al., 2021), retail sector has tremendously reduced their operational costs by applying IoT technology that helped in automated checkout, smart inventory management, better supply chain management and operating fully automated stores (Lee et al., 2022; Tu, 2018), and IoT for consumers attempts to offer efficiency and convenience on a personal level. Although the smart phone can be viewed as the pinnacle of consumer IoT technology, there are other prominent examples. These include trackers, voice-controlled home appliances (Shuhaiber & Mashal, 2019), smart watches (K. J. Kim & Shin, 2015), and other smart home gadgets (Gu et al., 2019). A snapshot of IoT applications in various contexts has been provided in Table 1.

IoT is defined as "a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies" (ITU, 2015). In other words, the IoT is about converting "dumb" things into "smart" by linking them to each other using the Internet (George et al., 2021). K. Ashton, a technologist, first introduced the concept of IoT in 1999 in the context of supply chain management (Sivathanu, 2018). The IoT technology enables physical equipment to be sensed and managed remotely (Balta-Ozkan et al., 2013) by creating a direct link between the physical world and computer networks (Palmaccio et al., 2021). IoT devices collect data from multiple interconnected equipments at one point, making the decision-making process easier and faster for the users (Tan and Wang, 2010).

Due to its inherent characteristics and promising advancements, IoT has the potential to make one's routine activities effortless. A report released by Fortune Business Insights revealed that the market size for IoT has reached 384.70 billion worldwide in 2021 and is expected to cross 2465.26 billion by the end of the year 2029 (Business-Insights, 2022). Such promising avenues have attracted the attention of researchers and marketers towards understanding the adoption phenomenon of this technology. Put succinctly, adoption-based articles primarily conduct empirical investigation of the factors that affect the degree of acceptance of the concerned technology. Indeed, there has been growing literature that has empirically validated the factors impacting the adoption of IoT devices in different contexts, including supply chain management (Lee and Lee, 2015; Tu, 2018), healthcare (Arfi et al., 2021;

Prayoga and Abraham, 2016), agriculture (Shi et al., 2022; Strong et al., 2022), smart homes (Mitalet al., 2018; Shin et al., 2018), education (Almaiah et al., 2022; Gökçearslan et al., 2022) and smart cities (Neupane et al., 2021; Sepasgozar et al., 2019). However, few studies attempted to synthesise the extant literature on IoT adoption into a systematic review. Also, these studies primarily focus on a particular application of IoT technology, failing to provide a comprehensive picture of the current body of knowledge in the concerned domain. Against this backdrop, this study intends to fill this research gap by providing the answers to the following research questions:

RQ1. What is the current state of knowledge of IoT adoption?

RQ2. What are the major adoption theories used in IoT adoption research?

RQ3. What antecedents, mediators, moderators, and outcomes entail IoT adoption research?

RQ4. What are the current gaps and future directions in IoT adoption research?

Table 1: Application areas of Internet of Things

Application areas of IoT	Description
Smart Home	A "smart home" is a convenient configuration of a home in which equipment and appliances can be controlled remotely and automatically from any place with an internet connection using electronic devices (Wei et al., 2019; Yang et al., 2018).
IoT in Agriculture	The IoT-based smart devices enable farmers to retrieve and process agricultural data remotely and automatically on real-time basis from field, which permits the farmer to manage the farm from home (Ayaz et al., 2019; Raj et al., 2021).
IoT in Education	Higher education institutions and schools embrace IoT to monitor student attendance, provide security, involve pupils in the learning process, and tailor instruction for students who need special attention.
IoT in Healthcare	IoT-based healthcare equipment empowers health experts to be more vigilant and associate with the patients actively. Further, healthcare system built on the Internet of Things allows network connectivity among all resources available to carry out healthcare tasks like remote surgeries over the Internet, diagnosing, and monitoring (Karahoca et al., 2018). Also, smart watch is used in healthcare in multiple ways including sleep monitoring, keeping track of activities, recording heart rate, and sending reminders throughout the day (Al-Maroof et al., 2021; Wang et al.,

	2022).
Smart City	The concept of smart city is referred as “an urban environment that mainly enhances the performance and efficiency of the regular city operations and the quality of services provided to the citizens using ICT and other related technologies, as well as to achieve the economic growth” (Sarker, 2022).

A systematic literature review based on “SPAR-4-SLR” (Paul, Lim, et al., 2021) using “TCCM” (Paul and Rosado-serrano, 2019) and “PRISMA framework” (Moher et al., 2010) has been conducted to provide transparent and robust results.

Answering these research questions would enhance the current understanding of IoT adoption by significantly contributing to the existing literature. First, by consolidating the findings of isolated and contradictory studies, this research will provide a comprehensive picture of research in the IoT adoption domain. Second, the available review articles have focused their attention on a particular application areas of this technology, viz. smart cities (Marimuthu et al., 2022; Murthy Nimmagadda and Harish, 2022; Nikki Han and Kim, 2021), education (Madni et al., 2022; Sneesl et al., 2022), smart homes (Jia et al., 2019; Li et al., 2021), smart health (Al-rawashdeh et al., 2022), and organisations (Ahmetoglu et al., 2022; Brous et al., 2020), while other studies reviewed the integration of IoT with other promising technologies in Industry 4.0 (Makhdoom et al., 2019; Shirkey et al., 2022). This research worked on this gap and systematically reviewed various application areas of this technology and provided a holistic view of IoT adoption. Third, structuring the current review based on the “TCCM framework” will help to gain a deeper insight into the dominant theories, contexts, characteristics, and methods employed in IoT adoption research. Also, this framework could provide an opportunity to the authors in delivering the highest level of clarity and coverage on the topic (Paul, Lim, et al., 2021). Furthermore, TCCM framework helps in proposing a comprehensive and holistic research agenda. Fourth, the results of the descriptive analysis revealed a pattern of research in the area of IoT adoption, enabling researchers to identify yearly publications, most researched countries, relevant journals, prominent authors, significant theories and methods. It will assist them in stimulating research in promising areas and avoid repeating work. Fifth, this study has developed an integrated conceptual framework that outlines antecedents, mediators, moderators, and outcomes that can be examined in various contexts. The antecedents are further divided into three categories: industry-specific enablers, common enablers and barriers to facilitate the interpretation of variables. They are also classified into four categories based on the TOE framework (Tornatzky et al., 1990) with an end-user-specific category. The snapshot of these variables will benefit academicians in studying factors impacting IoT adoption based on each aspect. Sixth, by highlighting the current research gaps and future agenda, this study provides a roadmap for future studies to examine the unexplored areas and enrich the current understanding of the topic. Seventh, the detailed analysis of variables influencing IoT adoption provides practical assistance to businesses, manufacturers and service providers in understanding consumers' decision-making process, which they can utilise while framing the marketing strategies for the adoption of IoT devices. Further, this would help the manufacturers to make IoT products as per the preferences of the consumers in the market and assist the service providers in providing high-quality services to the consumers.

The rest of the article is organised in the following sections. Section 2 outlines the methodology used to perform the systematic review. Section 3 illustrates finding of the study based on descriptive analysis, including year of publication, country, journal, theories used, methods used, and citation analysis. Section 4 develops the conceptual framework based on the antecedents, mediators, moderators and outcomes. Section 5 highlights the research gaps and research agenda for future research, followed by a theoretical and managerial contribution in section 6. Section 7 presents the conclusion of the study. Lastly, the limitations of the study are provided in Section 8.

2 METHODOLOGY

The literature contains a variety of review procedures that can be used to answer the research questions and achieve the objective of our study. Systematic literature review is one of the rigorous methods for locating, appraising, and synthesizing evidence (Petticrew, 2001). Additionally, it facilitates in articulating present knowledge gaps and thereby identifies future research directions (Gopalakrishnan and Ganeshkumar, 2013). Further, SLR follows an adopted or modified technique for organising data curation and analysis, enabling transparent and replicable results (Kraus et al., 2022). Numerous techniques are available to undertake systematic literature reviews (Paul and Rialp, 2020). These techniques include "Theme based reviews" (Paul et al., 2017; Paul and Dhiman., 2021), "Theory-based reviews" (Gul et al., 2018; Paul and Rosado-serrano, 2019), "Framework-based reviews" (Paul et al., 2021; Paul and Benito, 2018), "Hybrid reviews" (Dabić et al., 2020), "Review aiming for theory development" (Paul, 2016; Paul and Mas, 2019), "Bibliometric analysis" (Ruggeri et al., 2019), and "Meta-analysis" (Barari et al., 2020), "Morphological analysis" (Prashar, 2023; Samaddar and Menon, 2020), "Meta synthesis" (Ghoddoosinejad et al., 2023), Integrative review (Mäkinen et al., 2022; Marsh et al., 2022).

Due to the myriad of advantages offered by systematic literature review, we have adopted the framework-based systematic literature review in our study. To develop an integrated and updated framework of the existing body of knowledge in the field of IoT adoption, we have adopted the "SPAR-4-SLR protocol" proposed by (Paul, Lim, et al., 2021). Furthermore, we used the PRISMA framework (Moher et al., 2010) with SPAR-4-SLR to structure the flowchart of our study and explain the screening process while maintaining transparency and completeness in the systematic literature review. The rationale behind incorporating the

PRISMA framework as it has been extensively used in previous studies to standardize the screening process and review protocol (Casino et al., 2019; Falwadiya and Dhingra, 2022; Kumar et al., 2022; Moher et al., 2010).

The SPAR-4-SLR protocol comprises three sequential stages: assembling, arranging, and assessing, which are explained below.

2.1 Assembling

The Assembling stage includes identifying and acquiring literature for conducting systematic literature review. To ensure the articles taken into consideration completely represent the topic and are of superior quality, the study has used the "Web of Science" (WoS) and "Scopus" databases. The rationale behind using these databases in our study is that previous studies also adopted this database for conducting literature review (Ameen et al., 2022; Harju, 2022; Hassan et al., 2022; Jebarajakirthy et al., 2021; Palmaccio et al., 2021)**.** WoS and Scopus are multidisciplinary platforms that make it simple to access literature from all fields like management, technology, finance, psychology, etc. It also makes it easier to find the high calibre and most recent studies. The WoS and Scopus databases include journals with high citations and more coverage of recent articles than other databases (Aghaei Chadegani et al., 2013). Furthermore, Web of science provides better citation analysis and Scopus includes more Journals (Falagas et al., 2008). These databases are frequently used and widely acceptable in research society (Feliciano-Cestero et al., 2023; Ghoddoosinejad et al., 2023; Kumar et al., 2022). To extract the documents on IoT adoption, the search was done in the title field of these two databases. The premise for taking the title search in this study, as it helps to retrieve the documents which are primarily addressing the phenomena being studied. Further, many authors in their systematic literature reviews have frequently used title criteria to perform their search string (Casino et al., 2019; Nikki Han and Kim, 2021; Saihi et al., 2022). Finally, the selected keywords were searched in the title field to synthesis the literature in November 2022 using the following Boolean:

TITLE=(((“internet of thing*” or “iot*” or “internet of everything*” or “web of thing*” or “smart home*” or “smart cit*” or “smart retail*” or “smart watch*”) and (“adopt*” or “accept*” or “intent*”)))

2.2 Arranging

According to Paul, Lim et al. (2021), the arranging stage consists of two sub-stages “organizing” and “purification”. In the organizing stage, we first retrieved 823 publications through the Web of Science and Scopus using the above-mentioned Boolean in the month of November 2022. Further, articles are screened according to the following criteria: The articles which are not published in journals, written in language other than English, and in which the adoption of IoT is not the primary focus are excluded from the analysis. In the next step, duplicate records which exist in both Scopus and WOS databases were eliminated. Further, articles were once more screened based on title and abstract. To ensure validity and consistency, three researchers independently reviewed the titles and abstracts in the same way. The reproducibility of the selection is highlighted by the remarkable agreement of 98.27% among the researchers on appropriateness or unsuitability in this regard. Then, the authors conducted a full-text review of selected articles. Further, following the criteria used by Paul and Rosado-Serrano (2019) and Paul, Lim, et al. (2021), we limited the studies based on their “journal’s annual impact factor” (at least 1) or category “Q1/Q2” listed in SJR, to maintain the quality of the literature reviewed. Finally, 101 articles obtained that were employed for synthesis and “full-text review” (Appendix A). The flowchart of the study is based on “SPAR-4-SLR” (Paul, Lim, et al., 2021) and the “PRISMA framework” (Moher et al., 2010) provided in Figure 1.

Paul et al. (2021) advised using established frameworks for organizing systematic literature review to thoroughly analyze the body of literature. There are numerous techniques available to undertake framework based review, such as the “Antecedents, Decisions, and Outcomes framework” (Paul and Benito, 2018), “Theories, Contexts, and Methods framework” (Paul et al., 2017), “Theories, Constructs, Characteristics, and Methods framework” (Paul and Rosado-serrano, 2019), and “What, Why, Where, When and How framework” (5W1H) (Paul, Limet al., 2021). As a result, we used the TCCM framework (Paul and Rosado-serrano, 2019) proposed by Justin Paul and Rosado-Serrano to structure our systematic literature review.

The TCCM framework has been extensively used by the researchers while performing their systematic literature review (Abdulhak et al., 2022; Ameen et al., 2022; Basu et al., 2022; Billore and Anisimova, 2021; Chakma et al., 2021; Gupta and Dhingra, 2022; Hassan et al., 2022; Nanda and Banerjee, 2021; Sharma et al., 2022). Further, this methodology is appropriate for providing a thorough examination of current knowledge, highlighting research gaps, and proposing future research agenda in terms of (a) theories, (b) characteristics, (c) contexts, and (d) methodology in the reference of IoT adoption as illustrated in following Figure 2.

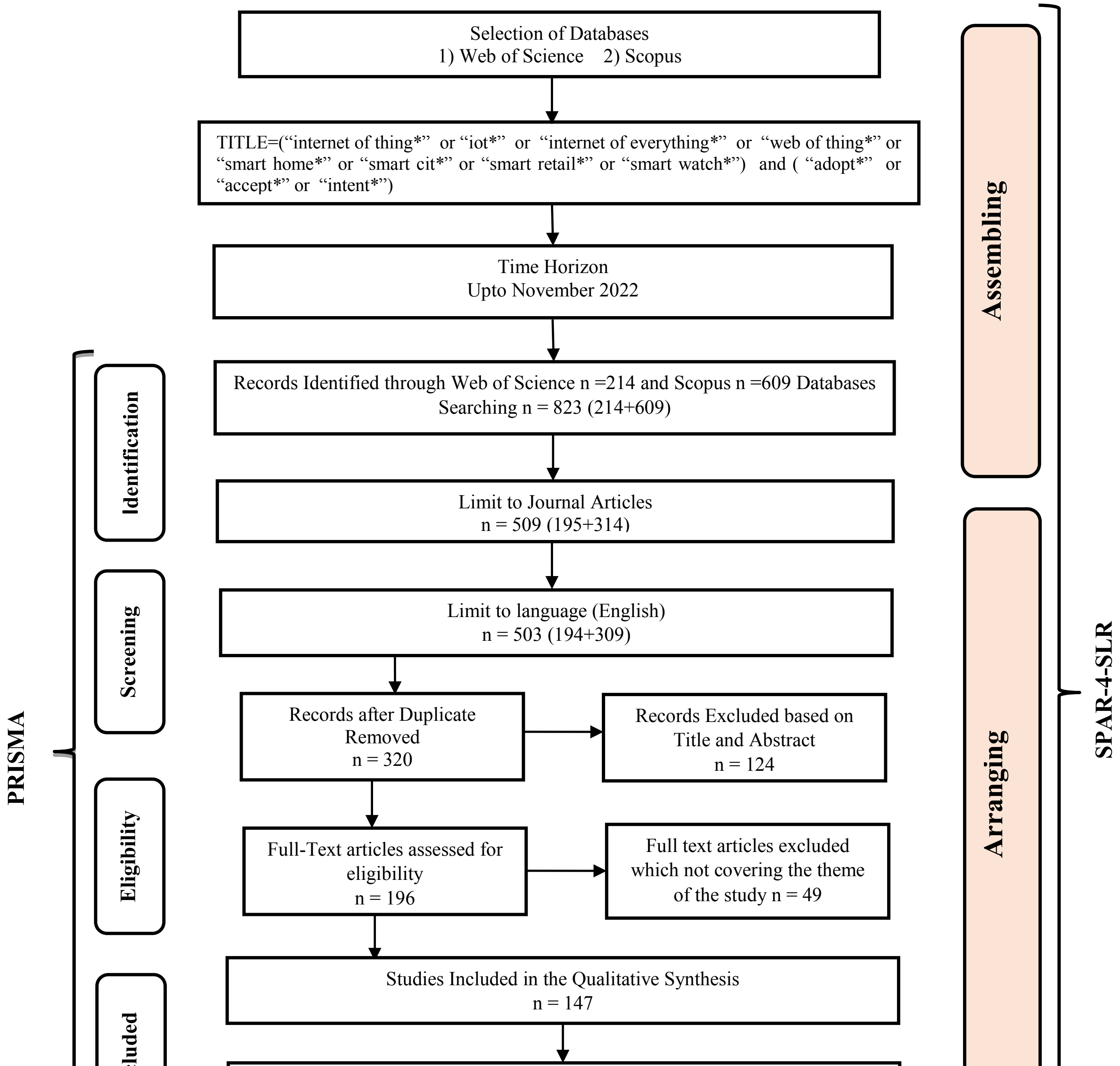
Selection of Databases
1) Web of Science 2) Scopus
TITLE=("internet of thing*" or "iot*" or "internet of everything*" or "web of thing*" or "smart home*" or "smart cit*" or "smart retail*" or "smart watch*") and ("adopt*" or "accept*" or "intent*")
Time Horizon
Upto November 2022
Records Identified through Web of Science n =214 and Scopus n =609 Databases Searching n = 823 (214+609)
Limit to Journal Articles
n = 509 (195+314)
Limit to language (English)
n = 503 (194+309)
Records after Duplicate Removed
n = 320
Records Excluded based on Title and Abstract
n = 124
Full-Text articles assessed for eligibility
n = 196
Full text articles excluded which not covering the theme of the study n = 49
Studies Included in the Qualitative Synthesis
n = 147
PRISMA
Identification
Screening
Eligibility
Assembling
Arranging
SPAR-4-SLR

Figure 1: Flowchart of the study (Moher et al., 2010; Paul et al., 2021)

3 DESCRIPTIVE ANALYSIS

In the descriptive analysis, we have provided the answers to the first three research questions of the study. To answer the research questions, we have systematically tabulated the selected 101 research publications based on the inclusion and exclusion criteria of the study in an excel file to maintain the transparent protocol. The table (appendix A) includes several components to demonstrate the findings, including publication year, sampling information, country context, methodology and citation counts of author, journal, and articles. Additionally, independents, mediating, moderating and consequences are also incorporated in the table. The analysis demonstrated the major areas of applications of IoT technology where articles have been published on IoT adoption. 29 articles are published in the context of Smart homes, followed by 22 articles on Retail Consumers, 13 articles on Smart cities and 13 articles in which industry type is not provided, as illustrated in Figure 3.

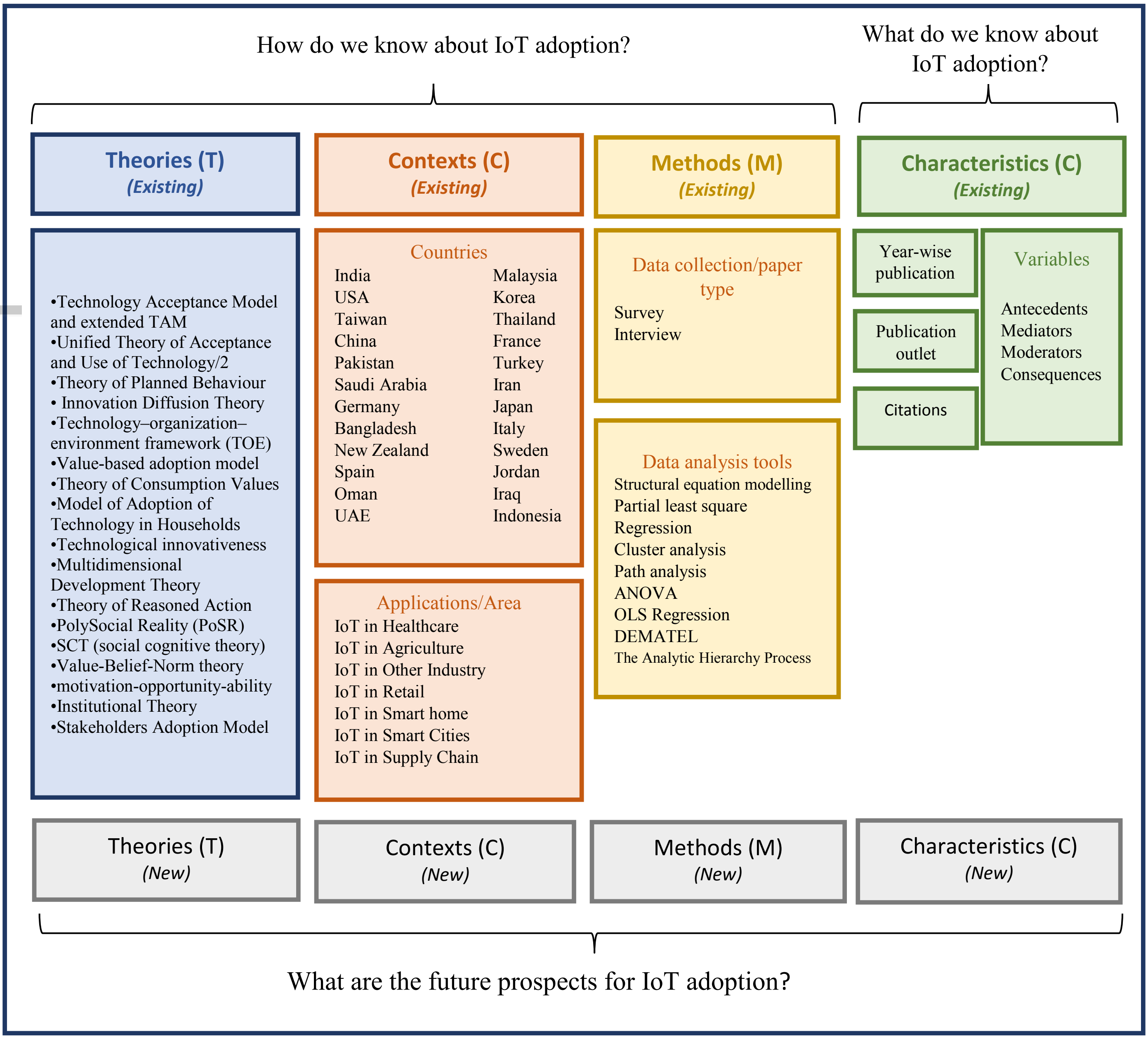

Figure 2: TCCM Framework (Paul and Rosado-serrano, 2019)

3.1. Year of publication

As illustrated in Figure 4, 2013 was the first year in which a study related to the Internet of things adoption was reported in the literature (Gao and Bai, 2013). Since then, the number of publications has been steadily rising. Out of 101 articles reviewed in the study, 19 articles were published in 2020, followed by 20 articles in 2021 and 23 articles till November 2022, indicating the increasing awareness and acceptance of the concerned technology. Previous studies done in the different application areas of IoT also supported this claim (Kumar et al., 2022; Leong et al., 2021; Li et al., 2021). This indicates the interest of various stakeholders, including researchers, policymakers and academicians toward the acceptance and use of IoT-based devices is steadily increasing.

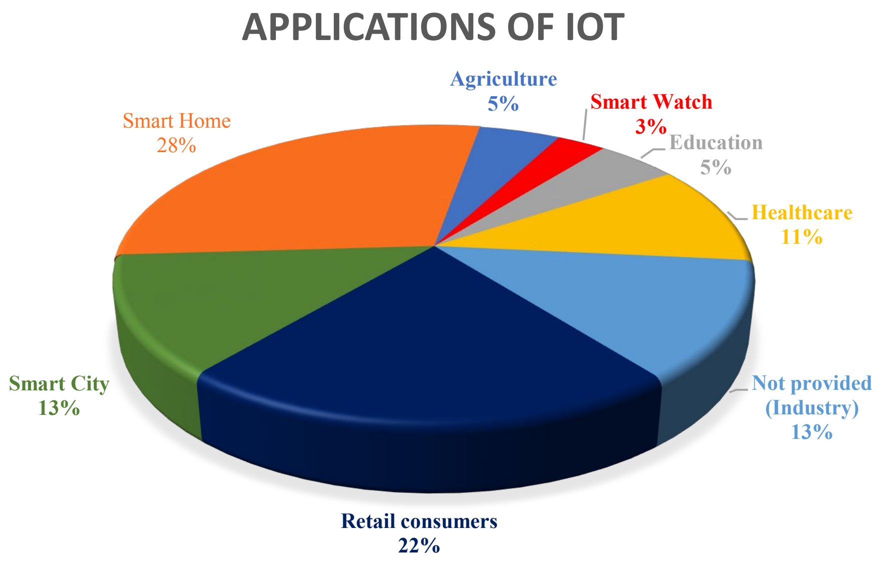

Figure 3: Applications of IoT

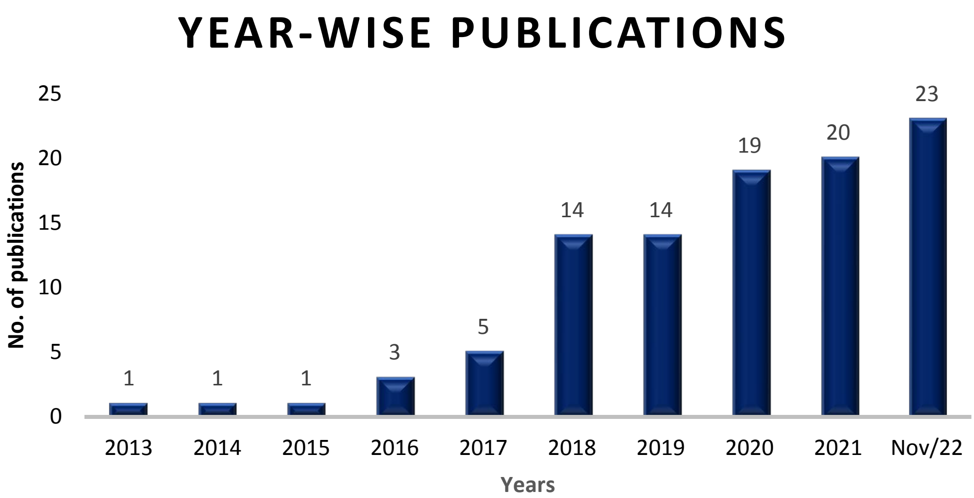

Figure 4: Publication trend

3.2. Country

Figure 5 represents the geographical coverage of the publication included in the SLR. Around 26.53% of all the articles are published in USA (12) and China (12), followed by Republic of Korea (10), India (7), France (5), Taiwan (5) and Malaysia (5). The remaining research has been conducted in Saudi Arabia (4), Thailand (3), Turkey (3), Jordan (3), UAE (3), Netherlands (2), Bangladesh (2) and Oman (2). The rest of the countries contributed 1 article each in this domain. Our review revealed that approximately 61% of the research has been conducted in the Asian region, indicating the increasing trend in the acceptance of IoT products. Further, it is also crucial to point out that researchers from emerging and developing countries must investigate this topic and offer potential future directions for IoT adoption and its application areas.

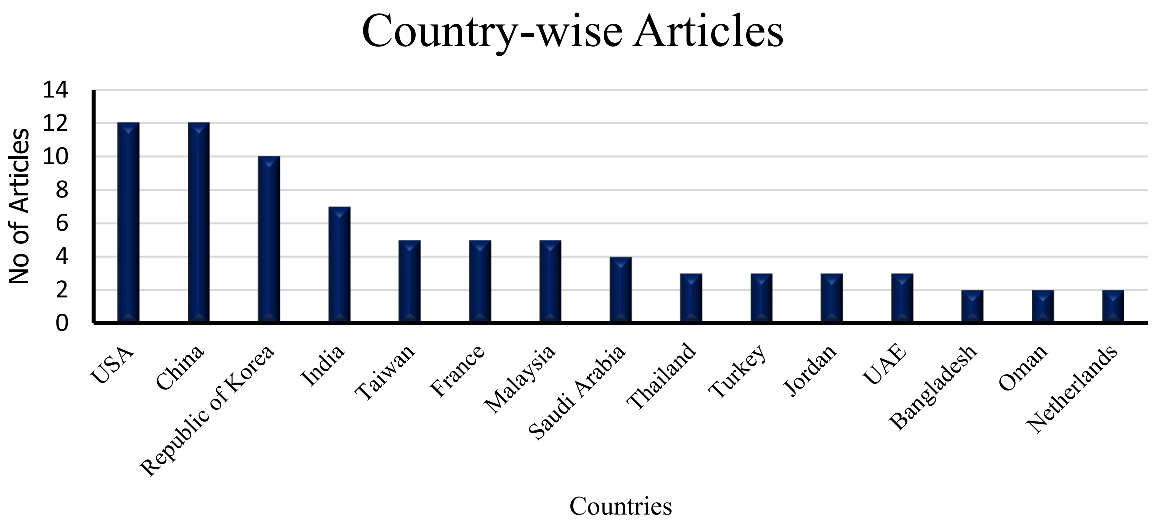

Figure 5: Country Wise Publication

3.3. Theories used

Researchers have used a variety of well-established models to comprehend consumer behaviour to explain the adoption phenomenon. To better understand the adoption process, they often either employed extensions, modifications, or a combination of models. To analyze the adoption behaviour of the respondents in the field of IoT technology, a total of 17 different theories, frameworks, and models have been utilized (Table 2).

The result demonstrated that the “Technology Acceptance Model (TAM)” (Davis, 1989) or extended TAM was used 10 times in the literature and 32 times combined with the other theories, which indicates that this theory contributed to 41.58% (42 articles) of the total articles published on IoT adoption. The other widely accepted theories are the “Unified theory of acceptance and use of technology” (UTAUT) (Venkatesh et al., 2003) and “Unified Theory of Acceptance and Use of Technology 2” (UTAUT2) (Venkatesh et al., 2012) adopted in 18 studies, “Technology–organization–environment framework” (TOE) (Tornatzkyet al., 1990) employed in 4 studies, “Innovation diffusion theory (IDT)” (Rogers, 2003) employed by 4 articles, and the “Theory of planned behaviour (TPB)” (Ajzen, 1991) adopted in 4 articles to unravel the IoTs adoption.

“Technology Acceptance Model” has been incorporated in different contexts including smart homes (11 times), smart cities (3 times), healthcare (3 times) and education (2 times). Further, the TAM model has been adopted in various studies with combination of other theories and constructs for enhancing the predictability of the model. Also, some researchers have incorporated the value-based adoption model in the context of consumers to mitigate the shortcomings of TAM model. Additionally, some studies have adopted the UTAUT and its extensions to measure the intention of the IoT users in smart cities (4 times), retail (4 times), agriculture (3 times), healthcare (3 times) and education (2 times).

It's interesting to note that some studies have dismantled the barriers established by conventional theories and introduced alternative theories of adoption into the literature to explain the intentions to use IoT. The new theories in IoT adoption literature are “Model of

Adoption of Technology in Households (MATH)" (Chatterjee et al., 2021), PolySocial Reality (PoSR) (Das, 2019), Multidimensional Development Theory (Pal, Zhanget al., 2021) and Theory of Consumption Value (Kasilingam and Krishna, 2022). "Model of adoption of technology in households" (MATH) is used to explore the constructs that affect the adoption of technology in private and non-mandatory settings (Chatterjee et al., 2021). MATH produced a noticeably deeper and more thorough understanding of household technology adoption (Brown & Venkatesh, 2005). Further, this model could demonstrate the use behaviour of aged consumers of smart homes. The "theory of consumption value" explains "why consumers choose to buy or not buy (or to use or not use) a specific product, why consumers choose one product type over another, and why consumers choose one brand over another" (Sheth et al., 1991). Further, this theory incorporates goal-oriented consumption in functional value and hedonic prospect in emotional value (Pura, 2005).

Table 2: Conceptual frameworks and theories used in literature

S.NO	THEORIES	FREQUENCY
1	Technology Acceptance Model (TAM) and extended TAM	42
2	Unified Theory of Acceptance and Use of Technology (UTAUT/2)	18
3	Theory of Planned Behaviour (TPB)	4
4	Innovation Diffusion Theory (IDT/DOI)	4
5	Technology–organization–environment framework (TOE)	4
6	Value-based adoption model (VAM).	3
7	Theory of Consumption Values (TCV)	2
8	Model of Adoption of Technology in Households (MATH)	1
9	Technological innovativeness (TI)	1
10	Multidimensional Development Theory (MDT)	1
11	Theory of Reasoned Action (TRA)	1
12	PolySocial Reality (PoSR)	1
13	SCT (social cognitive theory)	1
14	Value-Belief-Norm (VBN) theory	1
15	Motivation-opportunity-ability (MOA)	1
16	Institutional Theory	1
17	Stakeholders Adoption Model (SSA)	1

3.4. Methods used

After a thorough review of the articles on IoT adoption, we found that these studies incorporated various quantitative (Surveys through questionnaires and face-to-face interaction) and qualitative (Delphi technique, focus group interviews, in-depth interviews) data collection techniques. Most of the authors have obtained their data from primary sources, such as IoT users or employees. These surveys are done in the offline and online modes. Further, the result shows that most of the studies have collected the data in online survey mode. The content analysis of the study also revealed that 96 articles collected data using the questionnaire and rest of the articles (5) followed interviews and mixed method approach.

Out of 101 reviewed articles, only one study (Shank et al., 2021) has performed longitudinal survey to investigate the perceived benefits and actual use of IoT smart homes.

Table 3: Techniques used for Data Analysis

TECHNIQUE	NO OF PAPERS	%
Partial Least Square	46	45.54
Structural Equation Modeling	38	37.62
Confirmatory Factor Analysis	6	5.94
DEMATEL	2	1.98
Importance Performance Map Analysis	1	0.99
Multi Group Analysis	1	0.99
Regression	1	0.99

Partial least squares-structure equation modelling (PLS-SEM) is the most popular method employed by authors (46 papers) to investigate the interactions among variables. PLS-SEM has gained popularity recently due to the covariance-based SEM's increasingly strict requirements for model complexity, sample size, and distribution assumptions. Also, it makes it simple to describe higher-order constructs. Additionally, other approaches have also been employed by the researchers, including SEM (38), CFA (6), DEMATEL (2), IPMA (1), PLS MGA (1) and OLS REGRESSION (1) which is provided in Table 3.

3.5. Citation analysis

Citation analysis is one of the most commonly used methods for evaluating the impact of academic studies. When writing their publications, researchers mention the literature to substantiate their theories and appreciate the work of other studies. Consequently, the number of citations gives a rough estimate of the importance of research works (Peng and Zhou, 2006). The citation counts of the 101 research publications that were reviewed are then sorted in Excel to identify the articles, authors, and journals that are often cited.

3.5.1. Highly cited articles

According to the number of citations generated as of November 25, 2022, the top 20 articles from 101 reviewed publications are listed in Table 4. The analysis was carried out by conducting a title search in the "Scopus" database and tabulating each citation's number. Kim and Shin (2015) received the highest citation (345) among 101 publications in this review. They have studied the continuous intention of smart watch users. For predicting the behaviour in South Korea, they have adopted the extended TAM model and further validated it using the CFA and SEM techniques. Further, Gao and Bai (2014) received the second-highest citation (271) in the list. They have used the TAM model in their article to examine the behavioural intention to use IoT devices. This research was conducted in China by collecting data from 368 respondents and SEM was employed to statically validate the model for examining IoT adoption. In this article, the effects of "perceived usefulness", "perceived ease of use", "social influence", "perceived enjoyment", and "perceived behavioural control" were all strongly supported by the findings. However, trust has little impact in forecasting the intention. The integrated model offers an additional explanation of user behavioural intention toward IoT adoption compared to the standalone TAM model. The third most cited study was conducted by Hsu and Lin (2016), which received 223 citations. This study was conducted in Taiwan, majorly focusing on the privacy aspects of IoT devices. The findings show that, while privacy concerns have a comparatively small impact on adoption, network externalities have a significant impact on how consumers perceive the benefits of usage. Yang et al. (2017) is the fourth most cited article. It advances the "theory of planned behaviour" (TPB). On the basis of information gathered from 216 survey samples, the research model and associated hypotheses are tested using "partial least squares analysis" (PLS). The findings indicate that the adoption of smart home services is influenced by a number of major factors, including mobility, security/privacy risk, and vendor trust. The fifth most frequently cited paper is (Tu, 2018), with a citation count of 141. This paper used the TOE framework to check the adoption intention of 130 top-level managers using PLS-SEM. The research model demonstrates that in contrast to "technological trust", "perceived advantages", "perceived costs", and "external pressure" are major predictors of IoT adoption intention. However, through perceived benefits, technological trust indirectly affects IoT adoption intention. The result reveals that most of the top cited papers were published in the year 2018 with a count of 7 articles.

Table 4: Citation count of top 20 articles out of 101 reviewed

AUTHOR(S) AND YEAR	TITLE	CITE
Kim and Shin (2015)	"An acceptance model for smart watches Implications for the adoption of future wearable technology"	345
Gao and Bai (2013)	"A unified perspective on the factors influencing consumer acceptance of Internet of things technology"	271

Hsu and Lin (2016)	"An empirical examination of consumer adoption of Internet of things services: network externalities and concern for information privacy perspectives"	223
Yang et al. (2017)	"User acceptance of smart home services: An extension of the theory of planned behaviour"	157
Tu (2018)	"An exploratory study of Internet of things (IoT) adoption intention in logistics and supply chain management: a mixed research approach"	141
Park et al. (2017)	"Comprehensive Approaches to User Acceptance of Internet of Things in a Smart Home Environment"	130
Kim et al. (2017)	"A study on the adoption of IoT smart home service: using Value-based Adoption Model"	122
Shin et al. (2018)	"Who will be smart home users? An analysis of adoption and diffusion of smart homes"	117
Sepasgozar et al. (2019)	"Implementing citizen centric technology in developing smart cities: A model for predicting the acceptance of urban technologies"	113
Jayashankar et al.(2018)	"IoT adoption in agriculture: the role of trust, perceived value and risk"	88
Hsu and Lin (2018)	"Exploring Factors Affecting the Adoption of Internet of Things Services"	85
Hsu and Yeh (2017)	"Understanding the factors affecting the adoption of the Internet of Things"	80
Park et al.(2018)	"Smart home services as the next mainstream of the ICT industry: determinants of the adoption of smart home services"	76
Karahoca et al. (2018)	"Examining intention to adopt to Internet of things in healthcare technology products"	75
Hubert et al. (2019)	"The influence of acceptance and adoption drivers on smart home usage"	67
Baudier et al. (2020)	"Smart home: Highly-educated students' acceptance"	60
Pal et al. (2018)	"Analyzing the Elderly Users' Adoption of Smart-Home Services"	56
Nikou (2019)	"Factors driving the adoption of smart home technology: An empirical assessment"	55
Al-Momani et al. (2018)	"Factors that influence the acceptance of Internet of things services by customers of telecommunication companies in Jordan"	51
Arfi et al. (2021)	"The role of trust in intention to use the IoT in eHealth: Application of the modified UTAUT in a consumer context"	50
Aldossari and Sidorova (2020)	"Consumer Acceptance of Internet of Things (IoT): Smart Home Context"	49

3.5.2. Journal-wise publication and citation

Appendix B depicts that the selected 101 articles are published in 64 different journals focusing on IoT adoption. "Technological Forecasting & Social Change" secured the top rank amongst these 64 publication outlets by publishing 7 articles on the topic, followed by "IEEE Access", "Sustainability" and "Technology in Society" each of which contributed 5 articles to the existing literature. Further, "Computer s in Human Behaviour", "Sensors", "Energies", and "Journal of Computer Information Systems" contributed 3 articles each in the existing table. The remaining papers, which comprised about 75% of the total, were published in 60 different journals, demonstrating the wide distribution of articles on IoT adoption.

Using "Elsevier's Scopus-indexed SCImago Journal Ranking (SJR)" database, these 64 journals have been assessed for citation analysis on the 25th of November, 2022. The top 10 journals with the highest number of citations are listed in Appendix B, highlighted in blue colour. We have used the interval from 2011 to 2022 to determine the most frequently cited journals. This time span was chosen to make the data easily accessible and highlight the current literature trend on IoT adoption. With a total citation count of 2321699, "PLOS ONE", an international multidisciplinary open-access journal leads the list. That covers different areas, including engineering, social sciences, and humanities as well as natural sciences and medical research. The list has subsequently included "Journal of Cleaner Production" (434852), "IEEE Access" (374522), "Sensors" (275544), "Sustainability" (206838), "International Journal of Environmental Research and Public Health" (174014), "Energies" (149108), "Frontier in Psychology" (134338), "Computers in Human Behaviour" (95306), "Journal of Business Research" (68595). Open-access journals notably receive more citations than journals that can only be accessed through subscription due to their wider distribution and easy accessibility.

3.5.3. Highly cited researchers

Table 5 lists the twenty authors who received the highest citation both in the domain of IoT adoption and in terms of total publishing. The number of citations of researchers in the Scopus database was used to perform the citation analysis. With an astounding 23686 citations, Yogesh K. Dwivedi's work has received the most citations, followed by Ooi, Keng

Boon with 9407 citations, Chong, Alain Yee-Loong with 7845 citations, Lin, Binshan with 7655 citations, and Johnston, Wesley James with 6885 citations. In the realm of technology adoption, Yogesh K. Dwivedi has made notable contributions that may be seen in his work. These authors' articles showcase some excellent work and innovative problem-solving techniques.

Table 5: Highly cited authors

S.NO	AUTHOR	DOCUMENTS	CITATIONS	H-INDEX
1	Dwivedi, Yogesh K.	571	23686	81
2	Ooi, Keng Boon	161	9407	62
3	Chong, Alain Yee-Loong	140	7845	50
4	Lin, Binshan	249	7655	49
5	Johnston, Wesley James	163	6885	41
6	Prybutok, Victor R.	277	6035	39
7	Van Deursen, Alexander J.A.M.	69	5981	35
8	George, Joey F.	134	5793	32
9	Ziefle, Martina	452	5597	37
10	Chan, E. H.W.	187	4970	38
11	Hsu, Chinlung	24	4578	15
12	Kar, Arpan Kumar	174	4501	36
13	Deng, Hepu	173	3804	28
14	Lin, Judy Chuan Chuan	32	3717	18
15	Bao, Yukun	113	3357	33
16	Park, Eunil	158	3322	32
17	Benbunan-Fich, Raquel	94	2866	30
18	Amankwah-Amoah, Joseph	141	2824	29
19	Zo, Hangjung	81	2698	24
20	Kwak, Daehan	22	2677	14

4. CONTENT ANALYSIS

In order to adopt new technologies, it is essential to determine the different factors which have negative or positive effect on the adoption. Through the rigorous systematic literature review, we have found that various factors have been used in past researches to investigate the intention of the different classes of users regarding IoT adoption. These factors are further categorized in different categories, including antecedent, mediators, moderators and outcome. Based on these categories, a conceptual framework is developed, which is presented in Figure 6.

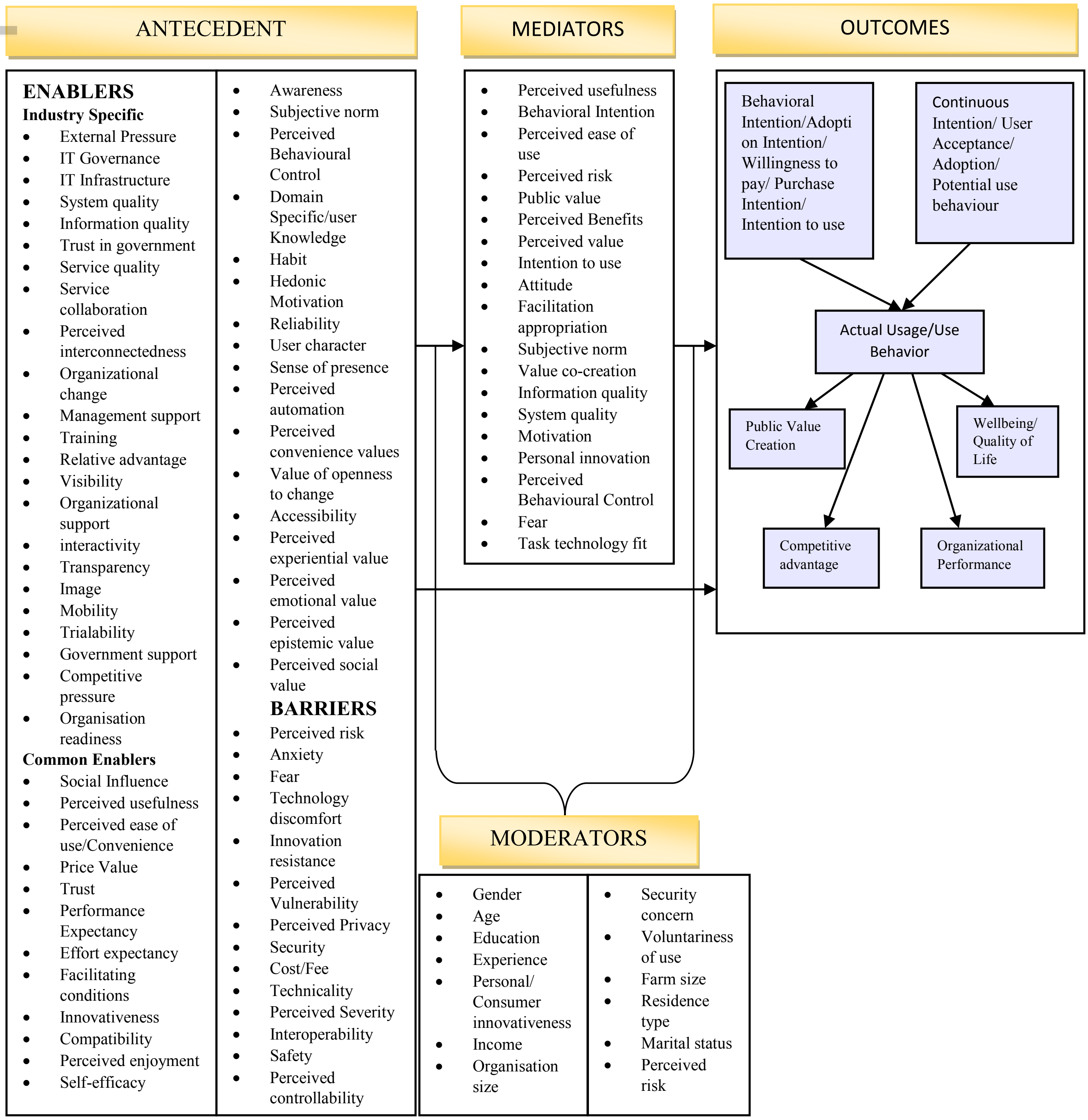

Figure 6: Integrated conceptual framework

4.1 Antecedents

Among the investigated enablers from the sample of our SLR, "social influence", "perceived usefulness" and "perceived ease of use" have the highest occurrence in the adoption of IoT. Social influence from the UTAUT theory is extensively used factor which has been validated by 31 previous studies. Venkatesh et al. (2003) defined "social influence" as the extent to which "an individual perceived that important others believe he or she should use the new system". Two factors from the "technology acceptance model", "perceived usefulness" (30 times) and "perceived ease of use" were the second most widely used variables in the list of enablers. Perceived usefulness means "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). This enabler is used in a task-related context. The related factor to the perceived usefulness are performance expectancy (Venkatesh et al., 2003), and relative advantage (Rogers, 2003). Davis (1989) defined perceived ease of use as "the degree to which a person believes that using a particular system would be free from effort". The factors analogous to "perceived ease of use" are "effort expectancy" (Venkatesh et al., 2003), convenience from enablers and complexity, and technicality from barriers. Other crucial enablers which have more than 10 frequencies in our sample are trust (20 times), cost (19 times), facilitating conditions (16 times), Innovativeness (11 times) and compatibility (11 times). For making the conceptual framework easy to comprehend, enablers were further divided into industry-specific and common factors.

The barriers which are investigated through the sample include cost (22 times), perceived privacy (20 times), perceived risk (12 times), security (9 times), technicality (4 times), perceived severity (2 times), perceived vulnerability (2 times), interoperability (2 times), fear (2 times), anxiety (2 times), safety (1 time) and perceived controllability (1 time), technology discomfort (1 time), innovation resistance (1 time). The result of the study revealed that cost is the main concern which is associated with the use of IoT products. Cost in terms of price value refers to the consumers' cognitive trade-off between the alleged advantages with regard to use a mobile services and monetary costs (Venkatesh et al., 2012). In the context of IoT, consumers have to bear several costs associated with the use of IoT products, including the cost of data service providers, cost of IoT products, maintenance and service charges. However, the consumer wants to use technological products which are expected to be cost-effective. Presently various previous studies indicated that costs of using IoT products are high and impact negatively (Al-Momani et al., 2018; Arfi et al., 2021; Chatterjee, 2020; Rey et al., 2021; Tu, 2018), which must be taken into account by the manufacturers and service products to work upon. Perceived privacy and perceived risk were the second and third most used barriers in past studies. Privacy means the potential loss of personal information control. Where perceived risk refers to an "individual's perception about the potential outcomes of an action owing to his or her degree of uncertainty about a particular behavior" (Arfi et al., 2021). Yildirim and Ali-Eldin (2019) presented privacy risks as a collection of concerns for unauthorized access to personal data, unauthorized secondary use, collection of personal information and concerns of errors in collecting personal information.

Furthermore, the antecedents can be grouped in different categories. We have grouped the antecedents in other four categories, including technological, organizational, environmental and end-user-specific factors (Sneesl et al., 2022). The three categories were taken from the "technology-organization-environment" (TOE) framework which was developed by (Tornatzky et al., 1990). The antecedents which were falling in these different categories are shown in Figure 7.

4.2 Moderators

Moderators refer to the factors impacting the direction of linkages between the two factors (Paul, Lim, et al., 2021). Further, they impact the strength among the antecedents, mediators and consequences (Lim et al., 2022). Various moderators have been studied in the existing literature regarding IoT adoption. The most prominently used moderators are gender (14 times) and age (12 times). Other demographic factors are also studied in past researches, including education (5 times), income (3 times) and marital status (1 time). Apart from demographic variables, other factors are also incorporated to investigate the moderating effect of personal/consumer innovativeness (3 times), perceived risk (1 time), security concern (1 time), organization size (1 time), and voluntariness of use (1 time) for the adoption of Internet of things. In the study by Arfi et al. (2021) used gender as a moderator between the independent and dependent variables in which they found, in case of male, "effort expectancy", "social influence", "perceived risk", and "facilitating conditions" significantly influenced the "behavioural intention". Whereas, in case of female respondents, only social influence and facilitating conditions were the main influencers of behavioural intention. In another study by Alraja (2022), the result reported that in case of generation Y, there is a moderating effect between "attitude-behavioural intention", "trust-risk perception" and "risk perception-attitude". Finally, Pal et al. (2019), demonstrated that there is a significant relation between "trust" and "continuous usage intention" for highly innovative individuals.

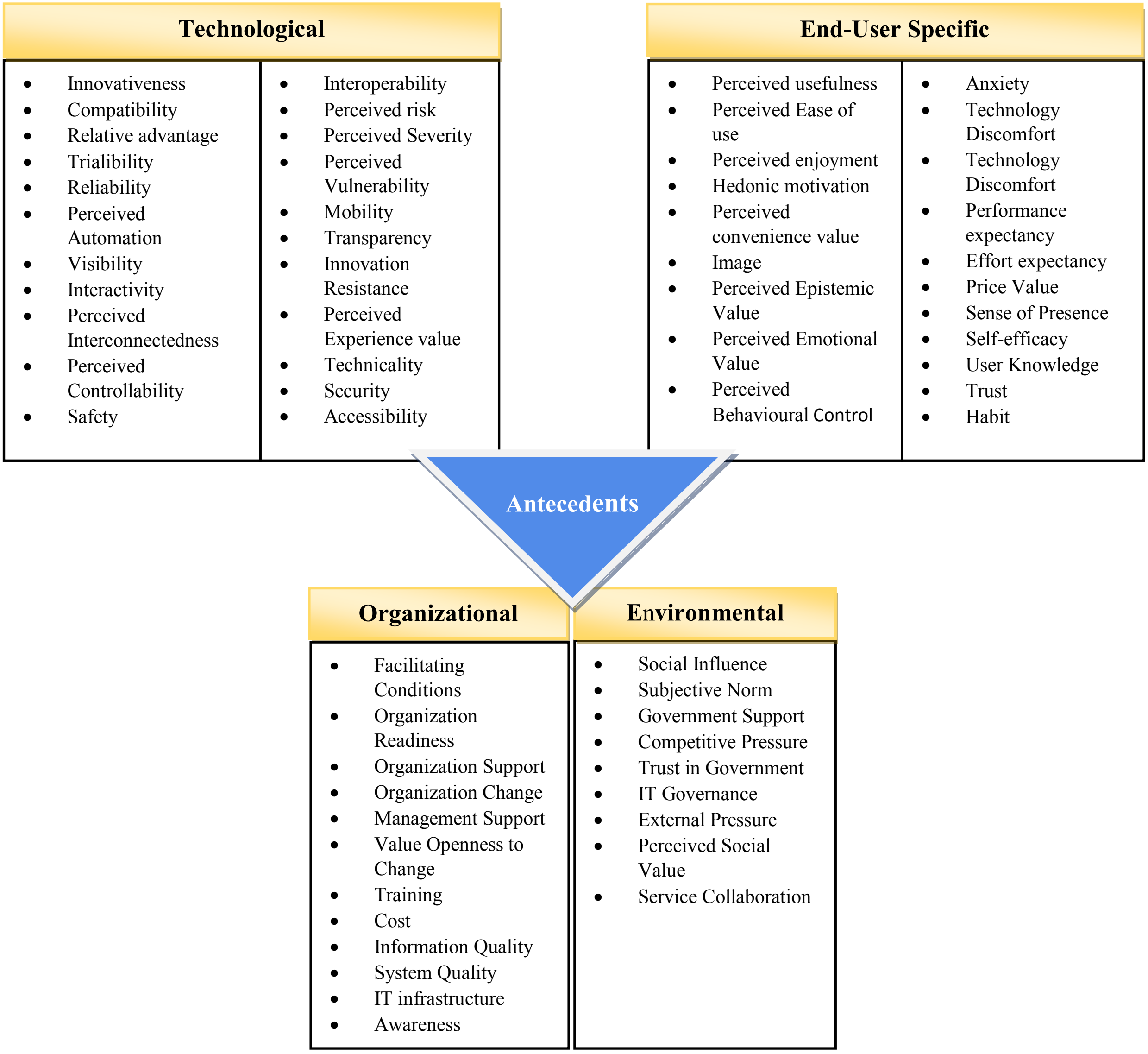

Figure 7: Classification of antecedents of IoT adoption

4.3 Mediators

Existing studies have used various variables as mediators to delineate the process in which two factors are related. Some of the antecedents and outcomes have been used as a mediator in the past studies depending on the context. The highest used mediators in the context of IoT adoption are attitude with a frequency of 25, perceived usefulness (17 times), behavioural intention (13 times), and "perceived ease of use". The other mediators are "perceived risk" (4 times), public value (3 times), trust (3 times), perceived value (3 times), facilitation appropriation (2 times), subjective norm (1 time), value co-creation (1 time), information quality (1 time), system quality (1 time), motivation (1 time) and personal innovation (1 time). Nawi et al. (2022) reported that attitude plays a mediating role between the "performance expectancy, facilitating conditions, perceived enjoyment, perceived trust, perceived risk" and "acceptance of IoT". Similarly, Maswadi et al. (2022) found a significant mediating role of attitude between "effort expectancy, performance expectancy" and "behavioral intention". Chohan et al. (2021) validated a mediating effect of public value between "information privacy value, digital society affinity, public trust value" and "continuous usage intention". Also, they have found the partial mediation of public value between "social influence value, citizens' empowerment value" and "continuous usage intention".

4.4 Outcomes

Outcomes are the resulting factors which are impacted by the antecedents, moderators and mediators. Our SLR reveals that several outcomes have been studied in past researches. Various outcomes indicating the similar meaning which were grouped together based on the concept matrix. Most of the studies used intention to use (50 times), continuous use intention (13 times) and actual usage (7 times) as the consequences in the context of IoT. Additionally, other studies have used different variables including user resistance, quality of life, public value creation, wellbeing, competitive advantage, and organizational performance. Further, we have shown the relationship among the outcomes in the conceptual framework, such as the fact that actual use or continuous usage of IoT products by a consumer improves their wellbeing (Lu, 2021) and quality of life (Chatterjee and Kar, 2018). On the other hand, the application of IoT products in organizations results in a competitive advantage (Das, 2019) and improved organizational performance (Lee et al., 2022). Finally, the IoT would enhance the value of residence living in smart cities (Chohan and Hu, 2020).

5. RESEARCH GAPS AND FUTURE RESEARCH AGENDA

A thorough analysis of the existing literature on the adoption of IoTs reveals that some aspects need scholarly exploration and critical examination. Based on the current analysis, this study illuminates the research gaps. Further, these research gaps are used to propose the future research agenda on the basis of TCCM framework.

5.1 Theory

- This literature evaluation demonstrated the dominance of a few theoretical models (TAM, UTAUT, TOE and DOI) and factors (trust, facilitating conditions, social influence, perceived privacy, cost, perceived ease of use and perceived usefulness) in describing consumers' intention to adopt IoT. Such hegemony of these conventional theories and factors directly results to monotony in the literature of technology adoption and prevents the introduction of new perspectives that could advance the adoption domain. However, scholars have been experimenting with novel ideas to comprehend the adoption phenomena. Therefore, there has been a progressive shift away from these conventional theories and models to other adoption theories in recent years. Also, researchers have used multiple new factors which can serve as facilitators in explaining the users' behaviour in IoT adoption. For example, value-based adoption trade-off between the benefits and sacrifice to measure the perceived value of the users. PolySocial Reality (PoSR) categorizes the different constructs in people, things and technologies. Additionally, validation of rarely used constructs such as "value of openness to changes" in behavioural reasoning theory and threat factors in Protection Motivation Theory could be further explored. Future studies may find it fascinating to use these ideas as a springboard for developing research models that are appropriate in various contexts.

5.2 Context

- Numerous studies have been done on the use of IoT in various sectors, including smart cities, smart homes, agriculture, healthcare, and other industries. However, few studies have been done so far on the smart education system, IoT-enabled agriculture, intention of society and government to adopt IoT smart cities. Globally, the adoption of smart cities has enormous potential; for instance, India is now working on the development of 100 smart cities under the project Smart Cities Mission, which is expected to complete in June 2023. Although effort has begun to transform conventional cities into smart cities, there is still a vacuum of study in the literature (Sharma, 2022). This research gap must be filled by researchers around the world in order to understand citizen expectations, potential adoption obstacles for smart cities, and future directions. There is a similar case of smart education system, IoT-enabled agriculture and IoT smart homes, which also require to be addressed by researchers, policy-makers and government.
- Our analysis revealed that many obstacles are inhibiting the mainstream adoption of the Internet of things, such as interoperability, perceived risk, privacy, and security. These challenges need to be considered while implementing IoT. Combining other cutting-edge technologies, such as blockchain, artificial intelligence, cloud computing, and the Internet of things, could lead to one possible answer to these problems. IoT devices gather massive amount of data which requires high storage capacity. It could be solved by integrating IoT devices with cloud computing technology. On the other hand, blockchain

technology could be a game changer in transmitting huge amounts of data on cloud platforms by providing security and mitigating the risk of data interception. Futher, artificial intelligence will convert the data into useful information, which can enhance the decision-making of the users. However, relatively little work has been done in this area up to this point. Future research should concentrate on expanding this area of study and looking for additional potential solutions.

- The finding of the study revealed that approximately 60% of the researches have been conducted in the Asian region, indicating the increasing trend in the acceptance of IoT products. Further, it is noteworthy to point out that researchers from emerging and developing countries must investigate this topic and offer potential future directions for IoT adoption and its applications.

5.3 Characteristics

- Most of the studies are empirical in nature, in which data was directly obtained from the respondents. However, the majority of the papers have not described the specific IoT devices whose intention is being evaluated and paid the least amount of focus on their unique traits, capabilities, and problems. A technology is more likely to be adopted by users if its features and designs match their needs, tastes, experiences, and social context. Research on particular IoT devices should be done with a focus on service-related issues.
- The majority of studies have explored behaviour intention and adoption. However, only a few researchers have focused on post-adoption impacts on users, namely continuous usage, creating public value, satisfaction, organizational performance, and well-being. Furthermore, the researchers establish the linkages between these variables, such as the fact that actual use or continuous usage of IoT products by a consumer improves their wellbeing and quality of life. On the other hand, the application of IoT products in

organizations results in a competitive advantage and improved organizational performance. Finally, the IoT would enhance the value of residence living in smart cities. Researchers are advised to conduct studies on these variables to enhance the understanding of the post-adoption behavior. Besides, other post-adoption factors, such as recommendation to use, e-wom, sustain usage, and sedentary behaviour, indicates promising area of research and contribute significantly to this field.

5.4 Method

- There are multiple sampling techniques available for primary research. After reviewing all of the articles, we have discovered that the majority of researchers use convenience sampling as a method of data collection, which can limit the applicability of the findings to the entire population (Alkhowaiter, 2020; Gupta and Dhingra, 2022). Furthermore, research has focused particularly on young and educated customers, they behave considerably different from the rest of society. Future studies should therefore use diverse sampling strategies and must study respondents from various age groups and educational levels. Furthermore, retailers, employees and corporates must be included in their sample frame.
- Our study revealed that few researchers (Shank et al., 2021) have attempted to explore the adoption phenomenon of IoT using the longitudinal survey approach. The longitudinal studies help in demonstrating the individuals' behaviour in IoT adoption by observing changes and pattern over the period of time. It aims to comprehend how individuals' behavior evolves throughout the adoption process and how these variations affect individuals' experiences and consequences. Future studies need to investigate the user behavior using longitudinal approach.

- As per the result of the study, most of the articles are quantitative in nature (95.04%). Only 5 articles have used qualitative and mixed-method approaches to understand the phenomenon of IoT adoption. Future studies can bridge this gap and enrich the current understanding by using different qualitative methods for their research including focus group, interviews, and ethnographic research to explore the users' insights towards IoT adoption. Such personal observation can help in identification of new variables and development of new theories, which can be empirically validated to understand adoption behavior.

5.5 Proposed research questions based on TCCM framework

Based on the identified gaps, we have proposed research questions in Table 6, which is in line with the previous systematic literature reviews (Billore & Anisimova, 2021; Ghorbani et al., 2022; Harju, 2022; Redine et al., 2023; Roy Bhattacharjee et al., 2022).

Table 6: Proposed research questions for future research.

TCCM	RESEARCH GAPS IDENTIFIED	FUTURE RESEARCH QUESTIONS
THEORY	Lack of research that introduces and investigates adoption behavior using unconventional theories	• What new theories could be undertaken for investigating the users' behavior for IoT adoption and post-adoption? • To what extent does the MATH theory explain the adoption and usage behavior of smart home diffusion and adoption?
CONTEXT	Lack of research in education and agriculture industry	• What are the main drivers of IoT adoption in educational settings, and how can these drivers effectively leverage the IoT adoption? • How can IoT-enabled smart farming systems contribute to better decision-making, optimise resource allocation, and boost the efficiency and sustainability of agricultural operations?
	Lack of studies providing potential solutions for shortcomings in IoT adoption	• How can IoT deployments be made resilient and safe while addressing vulnerabilities, privacy issues, and cyber security risks related to IoT devices?
	Few studies have examined the cross-country consumer behavior of IoT adoption	• Do users exhibit different behaviors in adopting IoT technology across various countries?

	Paucity of research on the integration of different technologies with IoT	• How different technologies including blockchain, cloud computing, artificial intelligence can facilitate in adoption of IoT technology?
CHARACTERISTICS	Lack of studies exploring the adoption characteristics in specific applications of IoT	• What are the factors influencing the acceptance of IoT in specific applications, and how do these factors differ from general trend of IoT adoption?
	Paucity of studies investigated the post-adoption consequences of IoT adoption	• How can IoT adoption contribute to sustainable developments? • How can Industrial IoT adoption contribute to organizational performance? • How can IoT adoption contribute to consumer wellbeing and quality of life?
METHODS	Dearth of studies conducting qualitative research on IOT adoption	• How can qualitative research methods, such as in-depth interviews and focus group, capture the complex social and cultural implications of IoT adoption in different domains?
	Lack of research investigating the IoT adoption using different set of research methods	• How can mixed-methods provide a comprehensive understanding of IoT adoption?
	Few researchers conducted longitudinal studies	• How do changes in user behavior and attitudes towards IoT adoption evolve over an extended period, and what are the underlying factors contributing to these changes?

6. CONTRIBUTION

6.1 Theoretical Contribution

By systematically synthesising the literature, this study enriches the current knowledge on IoT adoption based on various considerations. First, previous studies have reviewed on IoT in different domains; however, cumulative understanding of IoT has not been studied yet. In this regard, this study consolidates the existing literature of IoT adoption and draws a big picture in the concerned domain. Second, this study elaborates descriptive analysis of the articles, which provides knowledge on every aspect of this domain, including year-wise publication, country-wise publications and citation analysis. Third, this study highlights the important theories and methods which have been used to examine the adoption phenomenon of IoT in multiple domains. Fourth, this study has developed a conceptual framework based on antecedents, mediators, moderators, and outcomes. The antecedents have been divided into three categories, including industry-specific enablers, common enablers and barriers, which helps the readers to understand the antecedents easily. Lastly, the finding of the study helps the researcher to understand the current boundaries and future scope of the research.

6.2 Practical Contribution

This study not only contributes theoretically but also provides some practical implications. The study firstly suggests that professionals and managers responsible for the technological advancements in an organization, may use our research to comprehend the wide spectrum of IoT devices' applicability in managing their business. Secondly, the conclusions suggest that it is necessary to practically examine technological, environmental, organizational and end-user-specific variables that influence the implementation of IoT. Third, the finding of the study demonstrates various barriers affecting IoT adoption, which must be taken into consideration. Fourth, managers are advised to strategize their adoption plan subject to the barriers listed in the integrated conceptual framework. Lastly, the detailed analysis of these variables will help the business and manufacturers for making effective product manufacturing and services, which boost the speed of adoption of IoT products and services.

7. CONCLUSION

This study is essential since few studies in the literature have thoroughly examined the adoption of IoT technology. We have systematically reviewed the 101 publications on IoT adoption retrieved from the widely used database; Web of Science and Scopus. This study has adopted the methodology provided by Paul, Limet al. (2021), commonly known as SPAR-4-SLR. Further, to structure the flowchart of the study, we have employed the Prisma framework (Moher et al., 2010) with "SPAR-4-SLR" (Paul, Lim, et al., 2021). Additionally, we have followed the "TCCM framework" proposed by Paul and Rosado-serrano (2019) to thoroughly analyze the body of the literature, highlighting the current research gaps and providing future research agenda.

To answer the first two research questions, which enquire about the current state of knowledge and major adoption theories used in IoT adoption research, we have included multiple analyses; year-wise publications, country-wise publications, most prominent journals, citation analysis, theories, frameworks, and methods used in literature. It was observed that the study has constantly expanded and gained ground in terms of the number of publications over the years. It demonstrates that the major stakeholders are becoming more interested in adopting this technology. Additionally, we have discovered that the adoption of IoT technology is a multifaceted topic of research based on the number of articles listed in multidisciplinary journals. Furthermore, we have observed that the TAM model, followed by the UTAUT framework and TOE, are the most relevant theories in the context of IoT adoption.

This study has provided a comprehensive list of "antecedents", "moderators", "mediators", and "outcomes" which are employed by the researchers in the context of IoT adoption. Further, we have developed an integrated conceptual framework in which the antecedents are divided into two categories, including enablers and barriers, which lead to mediators or outcomes. Additionally, we have outlined the possible relationships among various outcomes used in IoT adoption based on the literature. Besides that, the antecedents are further grouped into four categories by employing the "Technology-organization-environment framework" (Tornatzky et al., 1990) with an end-user-specific category. The classification of factors would help the researchers and policymakers to comprehend this complex phenomenon. The factors that are empirically supported in the articles will have a significant impact on IoT users, which will aid producers in better understanding the needs of potential customers and improving their products. It will also assist policymakers in advancing the interests of consumers by creating better regulations.

8. LIMITATIONS AND SCOPE FOR FUTURE RESEARCH

The present research is exposed to a couple of limitations. First, the search process for this review is only restricted to the Web of Science with impact factor more than or equal to 1 and Q1 and Q2 categories in the Scopus database to maintain the quality of articles throughout the review, which narrowed the number of articles for this review. Therefore, other databases such as EBSCO, Google Scholar, and Science Direct can be opted for future research. Second, even though the researchers provide a comprehensive list of antecedents, moderators, and dependent variables used in the literature, the authors believe that the significance of these variables in affecting IoT adoption can be further researched. Third, this review was primarily focused on IoT adoption; future researchers can dwell on other issues, such as the IoT ecosystem, trust, and legal and regulatory frameworks. Fourth, there is a need to study the integration of IoT with other prominent technologies, including Blockchain, Artificial Intelligence, digital twins and Cloud computing.

Appendix A: Internet of things adoption literature

Author(s) and year	**Factors**	**Model /Theory**	**Method and No of Respondent**	**Application of IoT (sector)**
Hu et al. (2022)	Eco-Legitimacy, Eco-Responsiveness, Eco-Effectiveness And Eco-Efficiency ***Adoption Of Green Iot*, Advanced Manufacturing Technology, Green Innovation**	No model used	PLS SEM, 355, China	Industry
Jaspers and Pearson (2022)	Subjective Norm, Trust, Perceived Ease Of Use, Perceived Usefulness, **Intention To Use**, Privacy Concern, Prior Knowledge Of Privacy Invasion	TAM	PLS SEM, 930, New Zealand	Retail
Beştepe and Yildirim (2022)	Perceived Trust, Privacy Concerns, Perceived Cost, Personal Innovation, ***Intention To Use***, Social Influence, **Quality Of Life**, Quality Of Service	UTAUT 2	AMOS, 640, Turkey	Smart City

Song et al. (2022)	**Behavior Intention,** *Perceived Usefulness, Perceived Ease Of Use,* Trust, Self-Actualization Needs, Technology Anxiety, Mobile Self-Efficacy, Perceived Physical Conditions	TAM and STAM	SEM, CFA, 420, China	Smart Home
Brar et al. (2022)	*Perceived Usefulness*, PEOU, ***Attitude,* And Behavioural Intention**. Information Requirement Characteristics, Job Relevance and Trust in The Proposed System	TAM	AMOS 20 SEM, 257, India	Industry
Shi et al. (2022)	Facilitating Conditions, Performance Expectancy, Trust, Personal Innovativeness, Effort Expectancy, Government Support, Social Influence, Price Value, Hedonic Motivation **Willingness To Pay**	UTAUT 2	SPSS and AMOS, 345, Bangladesh	Agriculture
Xu et al. (2022)	*Willingness To Adopt*, Mimetic Pressure, Normative Pressure, Coercive Pressure *Green Management Innovation*, *Green Process Innovation, Green Product Innovation, Green Industrial Internet Of Things* **Organizational Performance**	Institutional Theory	PLS SEM, 318, China	Industry
Almaiah et al. (2022)	Learning Motivation, Technology Innovativeness, Optimism *Perceived Ease Of Use, Perceived Usefulness, Social Norms* **Intention To Use**	TAM	PLS SEM, 769, Oman and UAE	Education
Almazroi (2022)	*Perceived Usefulness, Perceived Ease Of Use,* **Behavioral Intention** Perceived Behavior Control, Anxiety, Enjoyment, Subjective Norm, Cost, Trust	TAM, TPB	AMOS SEM, 236, Saudi Arabia	Retail
Barachi et al. (2022)	Optimism, Innovativeness, *Satisfaction*, Empowerment, **Continuous Usage,** Inhibitors, *Discomfort,* Mistrust, Insecurity, Legal Ethics	No model used	SEM in AMOS, 350, students in the UAE	Smart City
Madias et al. (2022)	Perceive Knowledge, *Awareness of Consequences, Ascription of Responsibility, Personal Norms, Intention to Save Water* ,**Intention to Apply Smart Water Meters**	Value-Belief-Norm (VBN) theory	SEM, 532,	Retail
Liu et al. (2022)	Readiness, External Benefit, Facilitating Conditions, Technical Efficacy, *PEOU,* **Adoption Intention,** *Perceived Usefulness, Perceived Risk*	TAM, motivation-opportunity-ability (MOA)	CFA, 243, China	Healthcare
Nawi et al. (2022)	Perceived Risk, Technology Autonomy, Perceived Trust, Perceived Enjoyment, Facilitating Conditions, Social Influence, Effort Expectancy, Performance Expectancy *Attitudes Towards Iot*, **Acceptance of Iot**	UTAUT	CMV PLS, 357, Malaysia	Retail
Gökçearslan et al. (2022)	Individual Innovativeness, ICT Competency *Facilitating Conditions*, *Ease of Use, Usefulness* **Intention to Use**	TAM	SEM SPSS, 471, Turkey	Education
Cui et al. (2022)	Perceived Risk, *Attitude, Subjective Norms*, **Participating Intention**	TRA	AMOS SEM, 193, China	Smart City
Maswadi et al. (2022)	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Condition, Culture Influence, Technology Awareness, Education, Region, *Attitude,* **Behavioural Intention**	UTAUT	PLS SEM, 486, Saudi Arabia	Smart Home

Saylam and Ozdemir (2022)	Perceived Risk, Expected Cost, Compatibility, *Trust*, Perceived Usefulness, Perceived Ease-Of-Use, **Attitude Towards Using**	TAM+	AMOS SEM, 145, NATO	Industry
Bhadauria and Chennamaneni (2022)	Threat Factors, Perceived Threat Vulnerability, Perceived Threat, Severity, Anxiety, *Fear*, Self-Efficacy, Response Efficacy, Subjective Norm, Personal Innovativeness, Desire, **Behavioral Intention**	TRA, PMT	SPSS SEM,315, USA	Retail
Lee et al. (2022)	Challenges Of Iot Adoption (Organization Adjustment, Technology Trustworthiness) Benefits of Iot Adoption, (Supply Chain Efficiency, Visibility of Supply Chain) ***Supply Chain Performance*****, Organizational Performance**	No model used	PLS-SEM, 63, Malaysia	Supply Chain Industry
Dadhich et al. (2022)	Perceived Trust, Perceived Facilitating Conditions, Perceived Healthcare Threat, Social Influence, Effort Expectancies, Performance Expectancies **Behavioral Intention**	UTAUT	PLS-SEM, 290	Healthcare
Perumal et al. (2022)	Perceived Risk, Perceived Enjoyment, PEOU, Perceived Usefulness, *Attitudes Towards SRT* **Behavioral Intention Toward SRT**	TAM	PLS-SEM, 170, Malaysia	Smart Retail
Zhang and Liu (2022)	**Intention,** *Attitude* Information Publicity, Perceived Risk, Subjective Norm, Perceived Behavioural Control, Compatibility, Environmental Consciousness	Extended TPB	587 respondents having ESHS experience, China	Smart Home
Alraja (2022)	Security, Privacy, Trust - *Risk Perception, Attitude,* Perceived Behavioural Control, **Behaviour Intention**	TPB	PLS-MGA - 401 Oman	Healthcare
Kasilingam and Krishna (2022)	Perceived Experiential Value, Perceived Social Value, Perceived Epistemic Value, Perceived Convenience Value, Perceived Emotional Value, Perceived Playfulness, Personal Innovativeness, **Willingness to Pay**, *Attitude, Intention To Use*	Theory of Consumption Values (TCV)	PLS SEM, 1623, India	Retail
Wang et al. (2022)	Cost, Positive Body Image, Perceived Ease of Use, **Purchase Intention**, Personal Innovativeness Toward Technology, Perceived Usefulness For Health, Social-Adjustive Function, Value-Expressive Function.	TAM extended	PLS-SEM,303, China	Smart Watch
Al-Maroof et al. (2021)	**Adoption**, *Perceived Ease of Use, Perceived Usefulness*, Content Richness, Relevance, Timeliness, Sufficiency, Personal Innovativeness	TAM extended	PLS-SEM, 400, UAE	Smart Watch
Arfi et al. (2021)	Perceived Trust, Social Influence, Facilitating Conditions, Effort Expectancy, Performance Expectancy **Behavioral Intention,** *Perceived Risk*	UTAUT	PLS-SEM 267, France	Healthcare
Canziani and MacSween (2021)	*Opinion Seeking, Facilitating Conditions, Device Utility, Hedonic* Choice Confusion, Price Seeking Quality Seeking, Locus of Control Gender, Generation **Intention to Order**	TAM extended	PLS SEM, 1040, USA	Smart Home
Pal, Zhang, et al. (2021)	User Skill, Technological Aspect, Legal & Policy Aspect, Informational Concern, Physical Concern, Psychological Concern, **User Resistance**	Multidimensional Development Theory (MDT)	PLS-SEM, 463, Thailand	Smart Homes
Fazal-e-Hasan et al. (2021)	Perceived Risk, Perceived Compatibility, Perceived Efficacy, Perceived Novelty *Consumers' Intentions to Use SRT,* **Shopping Value, Interaction**	No model used	ANOVA SEM, 338	Retail

LEBRUMENT et al. (2021)	Professionalism And Empathy, Innovation And Creativity, Morality And Ethics, Internal Political Efficacy, External Political Efficacy, Identification with the City, Attachment with the City, Solidarity Towards the City *Public Administration Satisfaction* **Intention to Participate in the SC**	No model used	PLS SEM, 604, France	Smart City
Chatterjee et al. (2021)	Application For Personal Use, Friends And Family Influence (FAFI), Application For Fun (AFF),Secondary Source's Influence (SSI) Status, Fear Of Technology Advances (FOTA), PEOU, Declining Cost (DC), Cost **Intention to Use**	Model of Adoption of Technology in Households (MATH)	PLS, 349, India	Retail
Al-Husamiyah and Al-Bashayreh (2021)	Perceived Convenience, PEOU, Perceived Usefulness, Perceived Behavioral Control, Perceived Privacy Risk, Perceived Connectedness, Perceived Cost, Perceived Compatibility *Attitude* **Behavioral Intention to Use**	TAM	750, SEM, Jordan	Smart Homes
Rey et al. (2021)	Perceived Costs, Perceived Benefits, Absorptive Capacity, Innovation Capacity, Firm Size, **Iot Adoption**	No model used	Questionnaire, OLS regression, 79, Italy	Industry
Sun et al. (2021)	Personal Innovation, Social Influence, Perceived Risk, Effort Expectancy, Performance Expectancy *Personal Innovation,* **Adoption Intention**	UTAUT	AMOS, 264, China	Agriculture
Shimizu et al. (2021)	Justice, Trust, Benefit, Necessity, Risk, Social Acceptance	TAM	SEM, 568, Japan	Smart City
Kim and Wang (2021)	Reliability, Accessibility, *System Quality, Information Quality, Motivation,* Currency, Accuracy, Technology Discomfort, Knowledge, *PEOU, Perceived Usefulness,* **Intention to (Continue To) Use**	DeLone, TAM	AMOS, 262 South Korea	Retail
Chang and Nam (2021)	Convenience, Safety, Energy, Healthcare, **Intention to Use,** Gender, Age, Income. Education, Residential Type, Experience	No model used	SPSS, 400, Republic of Korea	Smart Home
Papagiannidis and Davlembayeva (2021)	Service Quality, Sustainability, Perceived Usefulness, Perceived External Control, Playfulness, Price, *Functional Value, Emotional Value,* **Intentions to Stay in Smart Accommodation,** PEOU, Control Over Experience, Entertainment Experience, Surveillance, Aesthetics	TCV	CFA, 430, UK	Smart Home
Tobarra et al. (2021)	Social Influence, Effort Expectancy, Facilitating Conditions, *User Attitude*, And *Intention of Use,* Performance Expectancy	UTAUT/TAM	Python 3 and SPSS, 129, Spain	Education
Park and Jeong (2021)	PEOU, Perceived Usefulness, Perceived Risk, Perceived Enjoyment, **Intention to Use**	TAM	909 Korea	Retail
Chohan et al. (2021)	Affinity, Digital Society, Citizens Empowerment Value, Public Trust Value, Social Influence Value, Information Privacy, ***Public Value*, Continuous Usage Intention**	UTAUT	PLS-SEM, 381, Pakistan	Smart City
Hasan et al. (2021)	*Attitude*, Relative Advantage, Compatibility, Risk Perception, *Subjective Norm*, *Value Co-Creation*, Innovativeness, **Behavioral Intention**	DeLone, DOI and TPB	PLS SEM with IPMA, 300 Bangladesh,	Healthcare
George et al. (2021)	Intent, Fear, Attitude, Privacy Concerns, Subjective Norms	TRA	AMOS, SPSS, 229,	Smart Home

			US	
Neupane et al. (2021)	Self-Efficacy in Information Security, Perceived Privacy, Government Policy, Perceived Information Security, Functionality and Reliability, Perceived Usefulness, Information Security Culture T*rust in Smart City Technologies*, **Adoption Intention**	TOE	SEM, 225, Australia	Smart City
Arfi et al. (2021)	Perceived Risk, Facilitating Conditions, Social Influence, Effort Expectancy, Performance Expectancy, Financial Cost- **Behavioral Intention**	UTAUT	PLS SEM, 181, France	Healthcare
Pal, Arpnikanondt, et al. (2021)	PEOU, *Perceived Usefulness, Attitude*, **Intention to Use,** Compatibility, Perceived Complementarity, Privacy Concerns	TAM extended	PLS, 315, Thailand	Smart Home
Hossain et al. (2021)	*Perceived Value, Health Interest, Attitude Toward a Wearable Device,* Trustworthiness, Personal Innovativeness, Self-Efficacy, Interpersonal Influence **Intention to Use**	TAM	PLS SEM, 97 Germany and Sweden	Healthcare
Mamonov and Benbunan-Fich (2021)	Negative Effects On Others, Privacy Concerns, Security Concerns, Malfunction Concerns, Perceived Relative Advantage, Perceived Usefulness, Adoption Intention	No model used	EFA, 558, USA	Smart Home
Shank et al. (2021)	Overall Benefit, Ease-of-Use, Data Sensitivity, Experience, Social Knowledge, Certainty, Positive Feelings, Innovativeness, Money, Safety, Time, Fun, Easy, Control, Advanced, Modern	No model used	641, USA	Smart Home
Ronaghi and Forouharfar (2020)	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Condition, Individual Factors, ***Behavioral Intention*, Use Behavior**	UTAUT	SPSS, 392, Iran	Agriculture
Alkawsi et al. (2020)	Facilitating Conditions, Performance Expectancy, Effort Expectancy, Social Influence, Habit, ***Behavioral Intention*, Use Behavior**	UTAUT	PLS SEM, 318, Malaysia	Retail
Pal et al. (2020)	Perceived Fee, Perceived Technicality, Enjoyment, Effort Expectancy, Performance Expectancy, Perceived Behavioral Control, Subjective Norm/Social Influence, PEOU, Perceived Usefulness, ***Attitude*, *Perceived Value*, Behavioral Intention**	TAM , UTAUT, TPB	PLS SEM, 436	Retail
Marikyan et al. (2020)	Regret, Guilt, Anger, *Attitude Change, Consonant Information Search, Behaviour Change,* **Perceived Wellbeing, Satisfaction,** Disconfirmation, Cognitive Dissonance	No model used	CFA, 387	Smart Home
Tsourela and Nerantzaki (2020)	***Attitude,*** Trust, Social Influence, Cognitive Instruments, **Behavioral Intention**, Cyber Resilience, *PEOU,* User Character, *Facilitated Appropriation, Perceived Usefulness*	TAM+	Amos SEM 16, 812 Greece	Retail
Alsuwaidan and Almegren (2020)	Perceived Usefulness, Perceived Ease of Use, Personal Competency, Transaction Intention, Social Network Reputation, Data Integrity Data Validity, Data Governance Data Privacy, Transaction Risk, Technology Risk, *Attitude, Data, Social, Security*, ***Behavior*, Adoption**	TAM+	SPSS-SEM, 85, Saudi Arabia	Industry

Alhasan et al. (2020)	Compatibility, Trialability, Self-Efficacy, Privacy, Image And Cost- *Ease of Use, Perceived Usefulness, Attitude*-**Behavioral Intention to Use**	TAM, IDT	Amos-SEM ,124, Iraq	Healthcare
Almugari et al. (2020)	Convenience, Social Influence Habits, Privacy & Safety, Awareness, Cost, **Adoption**	No model used	AMOS and SPSS, 467, India	Retail
Nuseir et al. (2020)	Entrepreneurial Competency, Entrepreneurial Self-Efficacy, *Entrepreneurial Education on Artificial Intelligence* Entrepreneurial Intention	No model used	PLS, 500, Saudi Arabia	Education
Chohan and Hu (2020)	Public Engagement, Service Transparency, Service Collaboration, Trust In Government, Decision Transparency, Service Quality, Information Quality, System Quality, *PEOU, Perceived Usefulness,* ***Use Behavior Intention*****, Public Value Creation**	TAM , Dlone	PLS SEM, 290, Pakistan	Smart City
Habib et al. (2020)	Effort Expectancy, Self-Efficacy, Perceived Privacy, Perceived Security, **Trust in Technology**, Price *Value,* Trust In Government, **Behaviour Intention**	UTAUT 2, Stakeholders Adoption Model (SSA)	PLS, 1444, USA	Smart City
Chen et al. (2020)	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, *Behavioral Intention***, Use Behavior**	UTAUT	SPSS, 282, Taiwan	Retail
Ehie and Chilton (2020)	IT Infrastructure, Staff Collaboration, Interoperability, IT Governance *IT/OT Convergence*, **Iot Adoption**	DOI	PLA SEM, 239, USA	Industry
Hou et al. (2020)	Performance Expectancy, Effort Expectancy, Social Influence, Perceived Cost, Prior Use of City Apps, Trust in Government, **Intention To Use,** Age, Gender, Education, Income	UTAUT	420, USA	Smart City
Aggarwal et al. (2020)	**Purchase Intent**, *Riskiness*, Coolness, Risk Knowledge	No model used	Effects logistic regression, 173, USA	Retail
Chuang et al. (2020)	Feelings of Self-Efficacy Regarding Computers, Organizational Support, Product Price, Average Annual Turnover, Perceived Convenience, Scale of Agricultural Land, Sense of Trust, Self-Efficacy Regarding Computers, PEOU, Perceived Usefulness, Organizational Support	TAM	SPSS, 241, Taiwan	Agriculture
Baudier et al. (2020)	Sustainability, Social Influence, Safety/Security, Personal Innovativeness, *Performance Expectancy,* Hedonic Motivation, Health, *Habit,* Effort Expectancy, Comfort/Convenience	UTAUT2	PLS SEM, 311, France	Smart Home, Education
Aldossari and Sidorova (2020)	Performance Expectancy, Social Influence, Effort Expectancy, Security Risk, Privacy Risk, Hedonic Motivation, *Attitude Toward Iot,* **Behavioral Intention** Trust, Price Value, Facilitating Conditions	UTAUT2	PLS-SEM, 343, US	Smart Homes

Hubert et al. (2019)	Compatibility, Triability, Result Demonstrability, *Peou, Perceived Usefulness,* **Behavioral Intention**, Visibility, Risk Time, Perceived Risk Performance, Perceived Risk Security, *Perceived Risk Overall*	TAN, IDT	SEM, 409, USA	Smart Home
de Boer et al. (2019)	Creative Skills, Social Skills, Information Navigation Skills, Mobile Skills, *Iot Skills, PU, Peou, Attitude*, **Intention to Use**	TAM	AMOS, 1356, Netherlands	Smart Homes
Yildirim and Ali-Eldin (2019)	Information Privacy, Ethics, Trust, Risk Perceived Usefulness, **Behavioural Intention**	TAM, TRA	PLS SEM and Adaptive Neuro-Fuzzy Inference modelling, 76 , Netherlands	Industry
Nikou (2019)	Triablability, Perceived Usefulness, PEOU, Observability, **Intention to Use**, Percieved Cost, Consumer Perceived Innovativeness, Compatibility	TAM, IDT, CPI	PLS SEM, 189, Finland	Smart Home
Kang et al. (2019)	Patient Safety, Work Efficiency, Medical Environment		R , 1086, South Korea	Healthcare
Kao et al. (2019)	Domain Specific Knowledge, User Innovativeness, Network Externality, Perceived Utility, Performance Expectancy, Perceived Usability ***Adopting Intention*****, Usage Behavior**	TAM	DEMATEL and PLS-SEM, 41, expert	Healthcare
Schill et al. (2019)	Environmental Beliefs, **Purchase Intentions**, Success, Age, Profession, Perceived Complexity, *Perceived Usefulness,* Happiness, *Environmental Concern*	No model used	SEM, 64l, France	Smart Home
Ji and Chan (2019)	Personal Norm, Social Norm, Perceived Behavioral Control, Economic Performance Attitude, Technical Performance Attitude **Adoption Intention**	TPB and NAM	PLS SEM, 1913, China	Smart Home
Gu et al. (2019)	Service Quality, Perceived Usefulness, Satisfaction, *Habit,* **Continuance Intention**	No model used	Amos SEM, 488, China	Smart Home
Das (2019)	People, Technologies, Processes, Interoperability, Data Security, **Competitive Advantage**, Things	PolySocial Reality (PoSR)	SPSS, 402, India	Industry
Pal et al. (2019)	Mobility, Usability, Security Concerns, ***Trust***, Social Influence, Privacy Concerns, **Continuance Usage**,		PLS SEM ,688, Thailand	Retail
Shuhaiber and Mashal (2019)	Trust, Awareness, Enjoyment, Perceived Risks, **Adoption Intention**, *Perceived Usefulness*, Perceived Ease, *Attitude*	TAM extended	PLS SEM, 258, Jordan	Smart Home
Sivathanu (2019)	Technology: IIot Expertise, IIot Infrastructure, Relative Advantage, Compatibility, Cost, Security Organization: Top Management Support, Organizational Readiness Environmental: Competitive Pressure, Support From Technology Vendors **Adoption of Industrial IoT in ACM Smes**	TOE	PLS-SEM, 136, India	Manufacturing Industry
Sepasgozar et al. (2019)	Organization Size Self-Efficacy, Work Facilitating, Compatibility, Relative Advantage, Perceived Usefulness, Perceived Reliability, Perceived Ease of Use, Cost Reduction, Time-Saving, Perceived Security, Low	TAM and SCT (social cognitive theory)	PLS SEM, 315, Iran	Smart City

	Quality of Service, Energy Saving, **Behavioural Intention.**			
Shin et al. (2018)	Compatibility, Privacy, PEOU, Perceived Usefulness, *Attitude,* **Intention To Use,** Age, Sex, Income, Education.	TAM extended	SEM, 310, Korea	Smart Home
Jayashankar et al. (2018)	Trust, *Perceived Value And Risk*, **IoT Adoption**		PLS-SEM, 492, USA	Agriculture
Karahoca et al. (2018)	Perceived Privacy Risk, Perceived Vulnerability, Image, Cost, Trialability, Compatibility, Technological Innovativeness, Perceived Advantage *Perceived Ease of Use, Perceived Usefulness, Attitude*, **Intention to Use**	TAM, innovation diffusion theory (IDT), technological innovativeness (TI)	PLS-SEM, 426, online Turkey	Healthcare
Chatterjee and Kar (2018)	Overall Innovation And Creativity, Resident Engagement, It-Enabled Service Quality, Perceived Privacy, Perceived Security, User Experience, Trust Level, **Quality of Life** **Personal Creativity and** Innovativeness, Usage Patterns, Demographics	No model used	SEM, 290, India	Smart Cities
Yang et al. (2018)	Perceived Reliability, Perceived Controllability, Perceived Interconnectedness, Perceived Automation **Adoption Intention** Resident Type, Gender, Age And Experience	No model used	PLS-SEM, 216, Korea	Smart Homes
Pal et al. (2018)	Universal Connectivity, *Perceived Ease of Use,* Security/Privacy, Enjoyment, *Perceived Usefulness,* Automation, Self-Capability, Satisfaction, **Behavioral Intention,** Compatibility, Affordability, Subjective Norm, *Attitude*	TAM extended	PLS SEM, 239, Thailand, Indonesia, and Malaysia	Smart Home
Al-Momani et al. (2018)	Trust In IT Knowledge, Cost, Privacy, Security, PEOU, Perceived Usefulness *Behavioral Intention***, Use Behavior**	TAM, UTAUT	SPSS, 176, Jordan	Industry
Buyle et al. (2018)	Optimism, *PEOU*, *Perceived, Usefulness,* **Use Intention**, Innovativeness, Discomfort, Insecurity	Technology Readiness and Acceptance Model (TRAM)	205, Belgium	Smart City
Tu (2018)	Perceived Trustworthiness Of Technology, Perceived Costs, *Perceived Benefits* External Pressure, **Adoption Intention**	TOE	PLS SEM, Grounded theory method, 130, Taiwan	Industry
Park et al. (2018)	Perceived System Reliability, Enjoyment, Perceived Cost, Perceived Connectedness, *PEOU*, Perceived Control, *Perceived Usefulness*, Attitude, Perceived Security, **Intention to Use,** Compatibility	TAM extended	SEM, CFA, 799, Korea	Smart Home

Hsu and Lin (2018)	"Benefits (Perceived Usefulness And Perceived Enjoyment) And Sacrifices (Perceived Privacy Risk And Perceived Costs)" *Perceived Value*, **Intention to Use the IoT Services**	Value-based adoption model (VAM).	AMOS SEM, 495, Taiwan	Retail
Park et al. (2017)	Perceived Compatibility, Perceived Connectedness, Perceived Control, Perceived Enjoyment, *PEOU, Perceived Usefulness, Attitude,* Perceived Cost, **Intention to Use**	TAM extended	SEM, 1057, Korea	Smart Home
Hsu and Yeh (2017)	Security: System Security, Institution Security, Data Security Environment: Competitive Pressure, Supporting Industry, Government Policy Organization: Organizational Readiness, Top Management Support, Expected Benefits Technology: IT Expertise, Technology Integration, Technology Infrastructure	TOE	DEMATEL, 42, Taiwan	Industry
Kim et al. (2017)	Perceived Sacrifices (I.E. Privacy Risk And Fee, Technicality, Innovation Resistance) Perceived Benefits (I.E. Usefulness, Enjoyment, Facilitating Condition) **Intention to Use, *Attitude, Perceived Value***	VAM	SPSS, 269	Smart Home
Yang et al. (2017)	Perceived Behavioral Control, Subjective Norm, Trust In Service Providers, Physical Risk, Security/Privacy Risk, Interoperability, Mobility, Automation *Attitude* **Intention to Use**	TPB extended	PLS, 216, South Korea	Smart Home
Hsu and Lin (2016)	Perceived Complementarity; Number of IoT Services, Perceived Critical Mass, Perceived Compatibility, *Perceived Benefits*, Collection, Unauthorized Secondary Use; Improper Access; Errors; *Attitude*; **Continued Intention to Use.**	No model used	508, Taiwan	Retail
Kim and Shin (2015)	*Attitude*, **Intention to Continue to Use,** *Perceived Ease of Use, Perceived Usefulness*, Perceived Affective Quality, Relative Advantage, Mobility, Availability, Sub Cultural Appeal, Cost	TAM extended	SEM CFA, 363, South Korea	Smart Watch
Bao et al. (2014)	*Perceived Usefulness*, Perceived Technology, Social Influence, PEOU, Perceived Cost, Perceived Secure Home, **Mobile Smart Home Adoption,** Security Risk, Compatibility	TAM extended	SEM CFA, 310, china	Smart Home
Gao and Bai (2013)	*Perceived Usefulness*, Perceived Behavioral Control, Perceived Enjoyment, Social Influence, Trust, Perceived Ease of Use, **Behavioural Intention to Use**	TAM	SEM, 368, China	Retail

Note: Excel sheet of 101 articles was used for the review. (In the factor column, *Italic* font denotes mediators, **bold** font denotes dependent factors, and normal font denotes independent factors used in the articles)

Appendix B: Journal-wise publications

S.no.	Journals	Papers	Citation	H-Index
1	Technological Forecasting and Social Change	7	47100	134
2	IEEE Access	5	374522	158
3	Sustainability	5	206838	109
4	Technology in Society	5	6011	58
5	Computers in Human Behavior	3	95306	203
6	Sensors	3	275544	196
7	Energies	3	149108	111
8	Journal of Computer Information Systems	3	3386	66
9	Uncertain Supply chain Management	3	1140	19
10	Future Internet	3	1664	38
11	PLOS ONE	2	2321699	367
12	Journal of Business Research	2	68595	217
13	Telematics and Informatics	2	15527	78
14	Information Systems Frontiers	2	8733	73
15	Universal Access in the Information Society	2	3320	46
16	Cogent Business & Management	2	2784	23
17	Journal of Cleaner Production	1	434852	232
18	Ecological Economics	1	44100	220
19	International Journal of Environmental Research and Public Health	1	174014	138
20	Frontiers in Psychology	1	134338	133
21	IEEE Internet of Things Journal	1	68343	119
22	European Journal of Marketing	1	9683	110
23	Industrial Management and Data Systems	1	11575	109
24	Computers in Industry	1	18396	108
25	Total Quality Management & Business Excellence	1	7289	87
26	Sustainable Cities and Society	1	41788	82
27	Behaviour and Information Technology	1	6757	82
28	the International Journal of Logistics Management	1	4788	80
29	International journal of consumer studies	1	5811	77
30	International Journal of Human-Computer Interaction	1	7193	76
31	Journal of Environmental Planning and Management	1	6870	75
32	Journal of Business & Industrial Marketing	1	6952	73
33	Technology Analysis and Strategic Management	1	5560	72
34	Information Technology and People	1	3723	64
35	Applied Nursing Research	1	4606	56
36	Journal of Ambient Intelligence and Humanized Computing	1	14548	52
37	Journal of Civil Engineering and Management	1	4379	52
38	Asia Pacific Journal of Marketing and Logistics	1	4534	51
39	Arabian Journal for Science and Engineering	1	22135	50
40	Frontiers in Environmental Science	1	8581	50
41	Electronics	1	23376	49
42	Interactive Learning Environments	1	6360	49
43	International Journal of Mobile Communications	1	1767	46
44	Aslib Journal of Information Management	1	2496	44
45	Kybernetes	1	4683	43
46	Library Hi Tech	1	2572	41
47	International Food and Agribusiness Management Review	1	1889	40
48	Journal of King Saud University-Computer and Information Sciences	1	5145	39
49	Journal of Organizational and End User Computing	1	1547	36

50	Buildings	1	6377	35
51	Journal Of Global Information Technology Management	1	889	33
52	Land	1	7084	32
53	Information Development	1	2140	29
54	Internet of Things	1	2707	27
55	Media and Communication	1	1997	25
56	Digital Policy, Regulation and Governance	1	1478	32
57	Information & Computer Security	1	2576	51
58	International Journal of Pervasive Computing and Communications	1	791	17
59	Information Resources Management Journal	1	505	43
60	Journal of Science and Technology Policy Management	1	1232	20
61	Hindawi-Journal of Sensors	1	9831	48
62	Smart health	1	573	13
63	Internet Research	1	8063	94
64	Frontier in Psychology	1	134338	133

*To reflect the performance of the specific journal and its influence during the specified period, the total citations incorporate citations from all of the publication's articles.

Note. The top 10 journals with the most citations are indicated in blue cells.

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Adoption of Internet of Things: A systematic literature review and future research agenda

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