

# Technology Acceptance Model (TAM): A Bibliometric Analysis from Inception

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**Abstract:** The technology acceptance model (TAM) has long-term implications for management studies. However, the evolution of the literature on technology acceptance ideas received very little attention in the bibliographic review. Few research reviews provided a systematic overview of the development and progress of the TAM literature based on the entire citation network, while many research reviews focused on re-examining the links between TAM components through meta-analysis. This study investigates: a) how TAM research has evolved and expanded over the last 30 years; b) the main areas in which the TAM model has been used; and c) key contributors to TAM research and their collaborations. This bibliometric analysis was carried out based on 8207 papers published in the Scopus database between 1990 and 2020 to assess the feasibility of the model and its applicability. The findings revealed that early TAM research was conducted both by Eastern and Western scholars and that it has since continued to evolve and be shared widely. Nonetheless, most TAM publications have focused on the same narrow domains of computer science, social science, business, management, and accounting and the trendiest topics were usefulness, trust, ease of use, e-learning, adoption, e-commerce, and social media.

**Keywords:** Technology Acceptance Model (TAM), Bibliometric Analysis, Theories on Technology Acceptance, TRA Model, UTAUT Model.

## Introduction

Leading companies frequently seek a competitive advantage to shape technological developments ([Lovelock, 2001](#); [Meyer-Brötz \*et al.\*, 2018](#)). However, continuous technological

change poses a threat to well-established business models while simultaneously presenting opportunities for the development of new services ([Lai, Chau & Cui, 2010](#); [Dasgupta, Gupta & Sahay, 2011](#); [Lai, 2016](#)). Several factors influence how quickly consumers adopt new technologies, including the availability, accessibility, usability, and prerequisites of those technologies, as well as the safety and security of those technologies, all of which are experiencing rapid and advanced technological growth ([Curran & Meuter, 2005](#); [Lai & Zainal, 2015a](#); [Lai & Zainal, 2015b](#); [Sahi et al., 2022](#)). The application of newly developed technologies by users has been the primary focus of some researchers.

Davis ([1989](#)) developed the Technology Acceptance Model (TAM), which illustrates the degree of interest of IT users to perceive and adopt new technology. And, since then, TAM qualifies as a remarkable achievement by any standard and has even attained the status of a sort of paradigm. Davis, Bagozzi & Warshaw ([1989](#)) have been cited more than 700 times so far, which is a very high number for a practical article like this one. In addition, the quantity and breadth of research carried out in the TAM tradition are both remarkable in terms of their respective scopes and volumes ([Bagozzi, 2007](#); [Marangunić & Granić, 2015](#)). Since TAM has maintained its position as the dominant model as a valid, robust, and user-friendly model for close to twenty years, it has received a great deal of feedback and has been the focus of a particular issue of a journal that is devoted solely to the model. The significance of TAM can be broken down into two categories: its direct impact and its indirect impact.

Perceived usefulness and ease of use are important independent variables for TAM, but it also relies on a dependent variable, such as attitudes toward use, to be truly useful. Davis ([1989](#)) gives definitions for perceived usefulness and perceived ease of use. Perceived usefulness is the degree to which a person thinks that using a system will help them do their job better. Perceived ease of use is the degree to which a person thinks that using a system is easy. Bagozzi, Davis & Warshaw ([1992](#)) say that the user's behaviour intention shows how they plan to use the technology. This behaviour intention is based on how the user feels about the technology and how useful they think it is. The widespread application of TAM in research has led to increased levels of consistency, as scholars rely almost exclusively on constructs known as "perceived utility" (PU), "perceived convenience" (PC), or "perceived ease of use" (PEoU) ([Aggrawal et al., 2020](#); [Eckhardt, Laumer & Weitzel, 2009](#); [Dwivedi, Williams & Lal, 2008](#)).

However, Benbasat and Barki's ([2007](#)) research showed that the overuse and excessive focus on TAM have taken researchers' attention away from other important research topics related to design and implementation, and behaviour- and performance-based impact on IS/IT adoption, which is very worrying, because constructs added over the years of research reflect one set of belief perceptions rather than expanding the understanding of what makes an IS/IT useful. In addition, several authors argued that an excessive emphasis placed on the

application of TAM had impeded the authors' knowledge of the progress that has been made in the field of IS/IT adoption and acceptance. This will be detrimental to the field, as it adversely affects the diversification and innovation of knowledge in IS/IT acceptance and adoption ([Venkatesh & Bala, 2008](#); [Wallace & Sheetz, 2014](#)).

The purpose of this paper is to explore the research status and development trend of TAM through a bibliometric analysis of academic publications. The first section of the paper presents TAM and its chronological evolution over three decades of the literature available. The second section provides a comparative bibliometric analysis of publications—examining the evolution of model publications over time, applications researched and studied fields, prolific countries, productive journals, and citations. The third section states the conclusion, the limitations of the study, and future research directions for budding scholars in the area.

## Prior Study and Theoretical Background

The literature on information systems (IS) and information technology (IT) contains a wide range of theories, models, and theoretical structures to address various implications, especially innovation. The list is exhaustive. Some of the theories being deliberated include:

1. Theory of Diffusion of Innovations (DIT) ([Rogers, 1995](#))
2. Theory of Reasonable Action (TRA) ([Ajzen & Fishbein, 1985](#))
3. Theory of Planned Behaviour (TPB) ([Ajzen, 1991](#))
4. Decomposed Theory of Planned Behaviour ([Taylor & Todd, 1995a](#))
5. Technology Acceptance Model (TAM) ([Davis, Bagozzi & Warshaw, 1989](#))
6. Technology Acceptance Model 2 (TAM2) ([Venkatesh & Davis, 2000](#))
7. Unified Theory of Acceptance and Use of Technology (UTAUT) ([Venkatesh et al., 2003](#))
8. Technology Acceptance Model 3 (TAM3) ([Venkatesh & Bala, 2008](#)).

Some of these theories of technology acceptance are summarized in Table 1.

**Table 1. Theories on technology acceptance**

Theory	Proposed scholar	Proposed theory
Diffusion of Innovation	Rogers ( <a href="#">1995</a> )	The author introduced an S-shaped adoption curve of innovators, early adopters, early majority, late majority and laggards.
Task Technology Fit	Goodhue & Thompson ( <a href="#">1995</a> )	Individual impact is based on the task characteristics, technology characteristics, performance impact and utilization
Theory of Reasonable Action (TRA)	Ajzen & Fishbein ( <a href="#">1985</a> )	They determined the intention of a person's attitudes towards behaviour attitude was impacted by behavioural beliefs and outcome evaluation;

Theory	Proposed scholar	Proposed theory
Theory of Planned Behaviour	Ajzen ( <a href="#">1991</a> )	subjective norms, impact factors are normative belief and motivation to comply. Extension of TRA- introduced an additional factor- perceived behavioural control
Technology Acceptance Model (TAM)	Davis ( <a href="#">1985</a> )	Includes two specific parameters: Perceived Usefulness (PU) and Perceived Ease of Use (PEoU)
Unified Theory of Acceptance and Use of Technology (UTAUT)	Venkatesh <i>et al.</i> ( <a href="#">2003</a> )	The model has four predictors of users' behavioural intention: performance expectancy, effort expectancy, social influence and facilitating conditions.

**Source: Authors' compilation**

Fishbein and Ajzen's research from the 1970s (published in 1974) demonstrated a comprehensive understanding of how to implement TRA in various technological contexts, such as the Internet ([Taylor & Todd, 1995b](#)). Davis ([1985](#)) analysed the factors that led to the development of technology and behaviour, and he systematically expanded TRA.

The initial TAMs included determinants for perceived ease of use (PEoU) and perceived usefulness (PU). As a result of the work of several researchers ([Karahanna, Straub & Chervany, 1999](#); [Venkatesh & Davis, 2000](#); [Wu, Chen & Lin, 2007](#); [Yen \*et al.\*, 2010](#)), as well as academics ([Venkatesh & Bala, 2008](#); [Yen \*et al.\*, 2010](#)), several revisions and extensions to the models have been made ([Gefen, Karahanna & Straub, 2003](#); [Karahanna, Agarwal & Angst, 2006](#)). TAM has also been successfully combined with existing theories and models from social psychology, cognitive psychology, humanistic psychology, positive psychology (Flow Theory), sociology, and information technology (among many others), to improve the explanatory power of individual models ([Al-Emran & Shaalan, 2021](#)).

An earlier study by Davis ([1985](#)) investigated computer usage behaviour and improved the technology acceptance model of the TRA (TAM) framework with its PU. The extension of the TAM model, named as TAM2, developed by Venkatesh & Davis ([2000](#)), looked at PU and the intention of use from the standpoint of social influence. Different empirical platforms have evaluated TAM for the validity of measurement. A potential application of TAM for innovative technology acceptance has backed various platforms, like education ([Kesting, Gerstlberger & Baaken, 2018](#); [Castiblanco Jimenez \*et al.\*, 2021](#); [Baby & Kannammal, 2020](#)), banking ([Kishore & Sequiera, 2016](#); [Kumar, Lall & Mane, 2017](#)), payment ([Carranza \*et al.\*, 2021](#); [Tassabehji & Kamala, 2009](#); [Qi, Carbó-Valverde & Rodríguez-Fernández, 2016](#)), trading ([Raman & Don, 2021](#)); cloud computing application ([Cengiz & Bakirtaş, 2020](#)); and social networking ([Ahmad & Farooqi, 2020](#); [Gunasagaran \*et al.\*, 2019](#)). TAM has gotten far ahead in reliability and applicability across these studies. During the prolonged COVID pandemic, there has been a steep rise in the TAM model employed to comprehend the factors influencing the usage and

acceptance of technology in different fields, especially in the education ecosystem ([Castiblanco Jimenez et al., 2021](#); [Mailizar, Burg & Maulina, 2021](#); [Mukred et al., 2021](#)).

On the contrary, previous studies have been limited in scope and relevance. They focused on the overall growth or expansion of a paradigm and its application in a particular field. Many studies considered it an outdated model, which is not applicable in the current scenario. TAM-based research is often rejected at the initial screening stage of publication in multiple high-quality publications. Bagozzi (2007) has bleakly slated TAM underpinning many advancements. According to his research, the study of TAM is “on the verge of crisis, if not chaos, in terms of explaining technology acceptance”. His research reveals two critical gaps:

1. The difference between intention and behaviour, as well as between behaviour and goal attainment;
2. The relationship between individual reactions to information use and intentions.

A similar criticism can be seen in Goodhue (2007), who appreciated the work of Benbasat and Barki (2007) in the area, highlighting the way scholars have overworked the model. On the one hand, he appraised the model’s importance and usefulness, stating: “Why don’t people make more use of information systems?”

TAM and its adaptations during the last 30+ years are examined using bibliometric analysis in this study ranging from 1990 to 2021 to ensure the relevance of earlier studies and assess if TAM still holds validation. More precisely, the study examined the evolution of TAM publications over time from its inception, identifying the well-researched applications, domains, countries, and the most prolific journals.

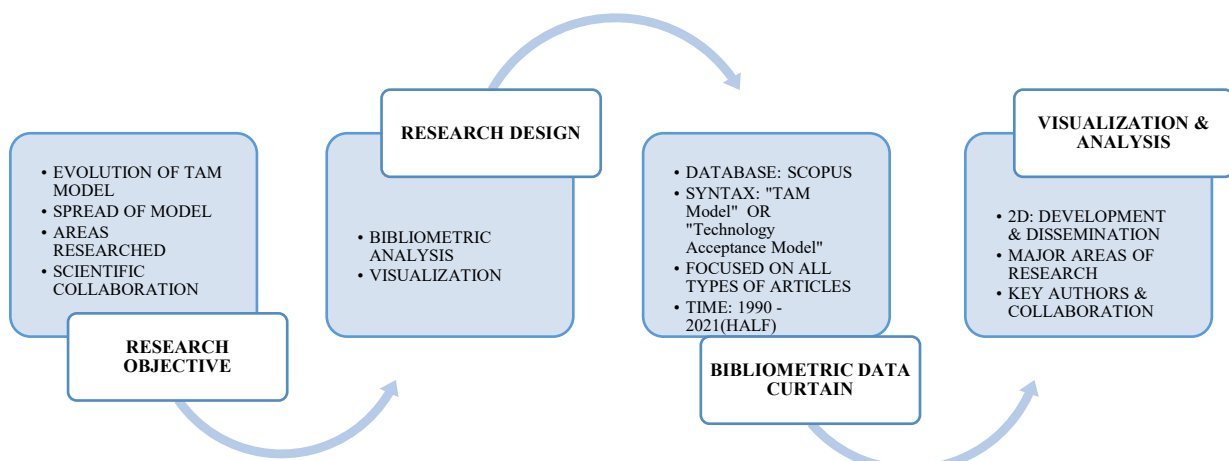
## Methodology

Unlike previous literature reviews, this study uses the evolving methodology of bibliometric analysis to identify the quantitative and qualitative changes in TAM and its applications. According to Zyoud *et al.* (2014), bibliometric analysis is commonly used to assess the quality of research studies and to reveal patterns and characteristics of a particular topic ([Abbas et al., 2020](#); [Ali et al., 2021](#); [Abbas et al., 2022](#); [Srivastava, 2020](#); [Alsharif et al., 2021](#); [Sikandar et al., 2022](#); [Van et al., 2021](#)). By assessing the number of publications and the number of citations received, bibliometric indicators can evaluate the scope and quality of underlying research investigations ([Sahi et al., 2021](#); [Bahuguna, Srivastava & Tiwari, 2022](#); [Roy et al., 2022](#); [Bakri & Willett, 2011](#); [Wahid, Ahmi & Alam, 2020](#)).

The VOSviewer tool is used for bibliometric mapping and display of results ([Van Eck & Waltman, 2014](#); [Ali et al., 2022](#)). Moreover, the tool is easy to use and advantageous for

creating and displaying extensive scientific maps in a fluid and convenient manner ([Mao et al., 2015](#)). This is due to the application of the data and the coverage of different sciences.

We used the Scopus scientific database for current analysis to examine publications containing “TAM Model” or “Technology Acceptance Model” in their title, abstract, or keywords. Scopus has one of the world’s largest abstract and citation databases, with 1.7 billion cited references from peer-reviewed publications. By analyzing its data, a full picture of the world’s research output is achievable. The international scientific community regards Scopus as one of the most essential sources of helpful information ([Lv et al., 2021](#)). Figure 1 presents the research flow of this paper. The study takes into account all categories of publications available in the Scopus database between 1990 and 2020. A total of 8207 articles were retrieved, including all types of publications. To draw a comprehensive picture of the TAM and its applications, all publication types were taken into consideration and further analyzed.



**Figure 1. Research flow (Source: Authors)**

The research distribution patterns in diverse subjects and eras were explained using bibliometric analysis as well as quantitative and statistical analysis in this study. The search was conducted on 14 June 2021, for all years. Although a bibliometric examination of the TAM Model was carried out by Al-Emran & Granić ([2021](#)), their study’s time frame was limited to the years 2010–2020. Their findings were based on information gathered from the WoS database. In this study, Scopus databases were used to provide 8207 documents related to TAM, which will make a different contribution from a database perspective.

We used the bibliometric approach to identify the evolution of the TAM model over years, check the main topics in this field, and identify the main authors of TAM models. Through the analysis, with the help of the search results tools, several results were immediately pulled from Scopus. Other data was manually entered or exported to a new Excel file. Information such as

percentages was evaluated from the file created for the outcomes. A VOSviewer was used to make pictures to aid the interpretation of the data. A final report was prepared, which provided findings and analysis in which we identified, analyzed, and summarised the results. We expect that this research will shed light on TAM publication trends. These findings can be used as a foundation for future research and discourse aimed at enhancing and improving this field of study.

## Results

The results of this bibliometric analysis are discussed in the current section regarding the following research questions:

RQ1. What constructed and propagated TAM research?

RQ2. What are the main subject topics discussed in TAM research?

RQ3. What are the main features that authors from various nationalities in TAM research have in scientific research collaboration?

## TAM Research: 2D – Development & Dissemination

This study investigated the following data to answer the topic of TAM research development and trends in its dissemination:

1. Number of publications by year;
2. Source Title;
3. Source and document type;
4. Document language.

### Publications by year

Statistics on yearly TAM research publications are provided in Table 2, and they show an upward trend from 1990 through the middle of the year 2020. In the year 1990, Scopus only indexed a single piece of literature that had been published (the first year TAM documents were published and indexed by Scopus). From 1990-2003, the Scopus database contained a total of fewer than one hundred reports of TAM documents. Surprisingly, there was a significant increase in the number of publications that were made available on TAM in the year 2007, with 206 documents being uploaded during that time. From 2008 to 2020, there was a consistent increase in the number, which indicates a growing interest in TAM (refer to Figure 2). The process of collecting and analysing data for this paper was finished in June of 2021, so the rest of the 2021 publications were not covered in this analysis.

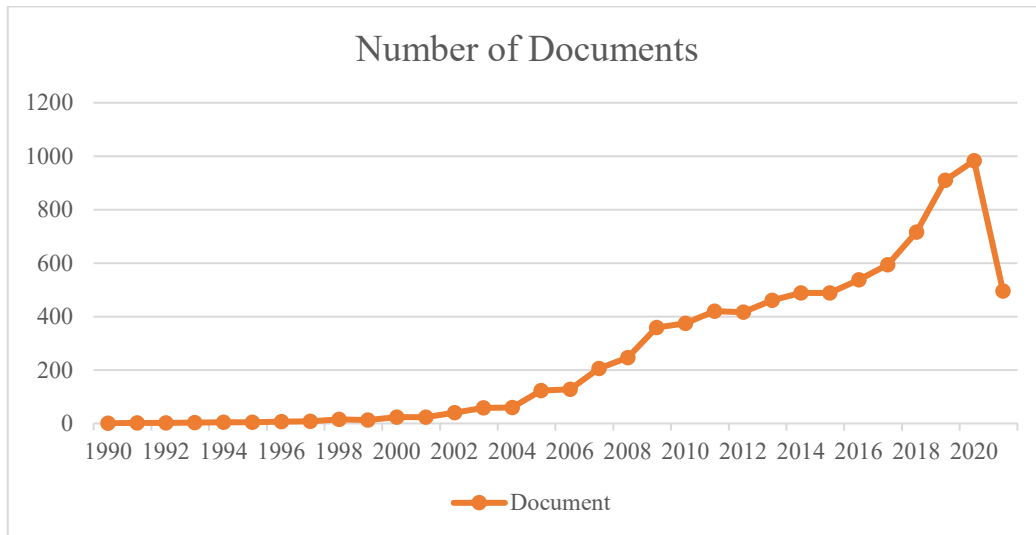


Figure 2. TAM overall publications by years

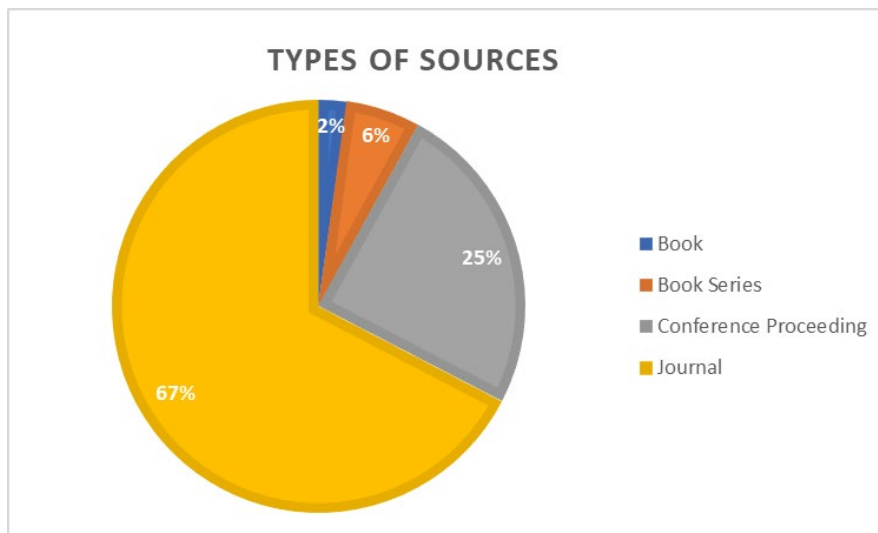
Table 2 Research Publications using TAM model (Source: Authors' analysis)

Year	Number of documents	Percentage
2020	983	11.98%
2019	910	11.09%
2018	716	8.72%
2017	594	7.24%
2016	538	6.56%
2015	488	5.95%
2014	488	5.95%
2013	461	5.62%
2012	416	5.07%
2011	420	5.12%
2010	374	4.56%
2009	359	4.37%
2008	246	3.00%
2007	206	2.51%
2006	128	1.56%
2005	123	1.50%
2004	59	0.72%
2003	58	0.71%
2002	40	0.49%
2001	23	0.28%
2000	23	0.28%
1999	13	0.16%
1998	15	0.18%
1997	8	0.10%
1996	7	0.09%
1995	4	0.05%
1994	4	0.05%
1993	3	0.04%
1992	2	0.02%
1991	2	0.02%
1990	1	0.01%
<b>Total</b>	<b>8,207</b>	<b>100.00</b>



## Sources and types of documents

The analysis of the documents based on the different source types is shown in Figure 3. The most popular source was journals, which accounted for around two-thirds of the total, 5,526 (67.33%); followed by conference proceedings, 2,018 (24.59%). Other sources like book series, books, and trade journals, with one unidentified source, formed 8.07% of the total sources available.



**Figure 3. Types of sources contributed using the TAM model**

Further, the analysis was done to identify the type of relevant documents contributed in this field. A total of 5312 articles (64.71%), equivalent to more than half of all publications, as indicated in Table 3, contributed to this field. It was followed by conference papers, which were 2,425 (29.54%) in number. This indicates that not only the articles published in journals but also conference papers are getting a good number of publications in this field.

**Table 3. Document Types using TAM model (Source: Authors' analysis)**

Document Type	Number of documents	Percentage
Article	5310	64.71%
Conference Paper	2425	29.54%
Book Chapter	229	2.79%
Review	164	2.00%
Conference Review	51	0.62%
Note	9	0.11%
Editorial	7	0.09%
Data Paper	4	0.05%
Erratum	3	0.04%
Book	2	0.02%
Retracted	1	0.01%
Undefined	2	0.02%
<b>Total</b>	<b>8,207</b>	<b>100.00</b>

## Relevant sources

According to the relevant sources contributed in this field, “Computers in Human Behavior” has the maximum number of publications using the TAM model (n=137), followed by the ACM “International Conference Proceeding Series” (n=128) and “Lecture Notes in Computer Science” (n=126). The top 20 sources for publishing TAM information are listed in Table 4.

**Table 4. Top 10 sources contributed using the TAM model (Source: Authors’ analysis)**

Source Title	Number of documents	Percentage
Computers in Human Behavior	137	1.67%
ACM International Conference Proceeding Series	128	1.56%
Lecture Notes in Computer Science	126	1.53%
Sustainability Switzerland	80	0.97%
Advances in Intelligent Systems and Computing	75	0.91%
Behaviour and Information Technology	71	0.86%
Education and Information Technologies	64	0.78%
Information and Management	64	0.78%
Computers and Education	61	0.74%
Journal of Theoretical and Applied Information Technology	54	0.66%

## Language

Table 5 shows that English is the most popular language, accounting for 98.10% of the publications. The second most popular language was Spanish; the remaining records were released in nine other languages, including Chinese, Portuguese, French, German, and Persian. It is interesting to know that publication in this field is not contributing only to the English language, but also contributing to other languages.

**Table 5. Languages Used in TAM (Source: Authors’ analysis)**

Language	Number of documents	Percentage
English	8,053	98.10%
Spanish	62	0.76%
Chinese	36	0.44%
Portuguese	27	0.33%
French	21	0.26%
German	8	0.10%
Persian	7	0.09%

## Major Areas of Research in TAM

In this section, subject area, frequency of keywords, titles for documents and the primary areas of TAM research were analyzed.

## Major research areas using the TAM model

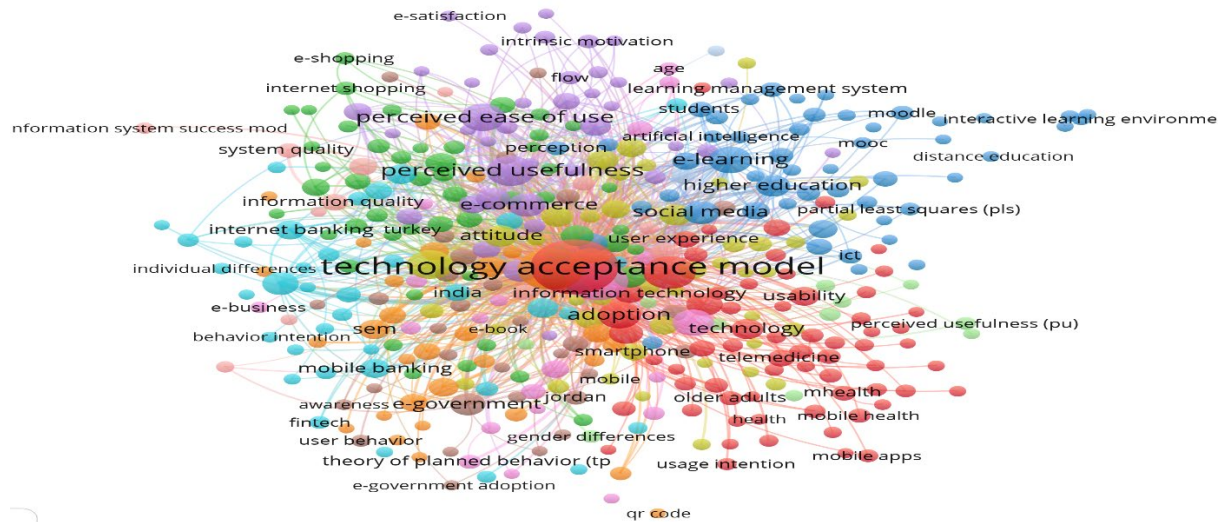
The classification of the documents based on the area of research is shown in Table 6. The result reveals that the maximum number of articles was contributed in the computer science field with 4409 publications (53.71%), followed by numerous papers in the social sciences with 2595 (31.61%). Other areas with more than 500 publications are business, management, accounting, engineering, decision sciences, medicine, and mathematics.

**Table 6. Relevant Areas of Contribution using the TAM model (Source: Authors' analysis)**

<b>Subject area</b>	<b>Number of documents</b>	<b>Percentage</b>
Computer Science	4409	53.71%
Social Sciences	2595	31.61%
Business, Management and Accounting	2246	27.36%
Engineering	1557	18.97%
Decision Sciences	935	11.39%
Medicine	635	7.74%
Mathematics	525	6.40%
Economics, Econometrics and Finance	470	5.73%
Psychology	421	5.13%
Arts and Humanities	394	4.80%
Environmental Science	231	2.81%
Energy	168	2.05%
Health Professions	165	2.01%
Nursing	131	1.60%
Materials Science	116	1.41%
Physics and Astronomy	115	1.40%
Agricultural and Biological Sciences	98	1.19%
Biochemistry, Genetics and Molecular Biology	81	0.99%
Multidisciplinary	78	0.95%
Chemical Engineering	46	0.56%

## Keyword analysis

The authors' chosen keywords are displayed in Figure 4, and each of those keywords appears at least ten times throughout the chart. Researchers made use of a piece of software called VOSviewer, which is designed to generate and display bibliometric networks so that they could map authors' keywords. In addition, the colour of the connected lines, the size of the circle, the size of the text, and the width of the lines all show connections with the other keywords. For instance, the terms associated with different colours were frequently grouped.



**Figure 4. Author keywords in network visualization map**

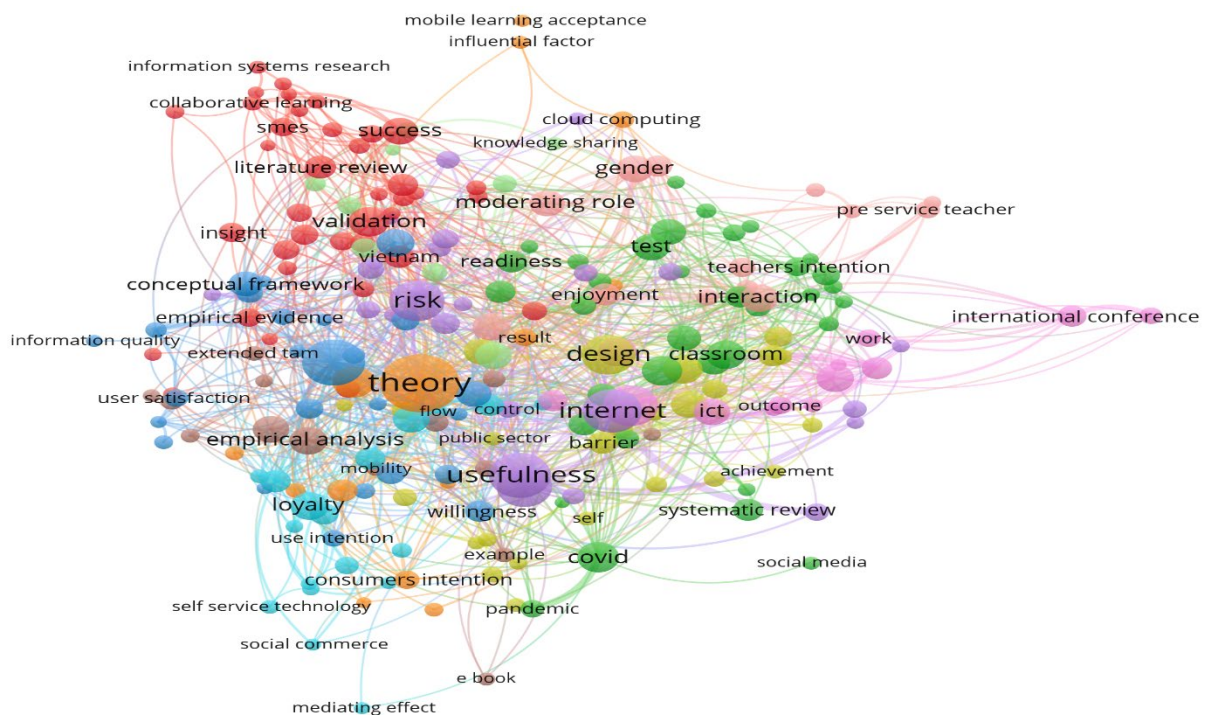
Table 7 shows the most frequently used keywords in the TAM model studies. The data revealed that the “technology acceptance model” was the keyword most used ( $n=3669$ ) in the publications. “Perceived usefulness and trust” were other major TAM-related keywords that appeared in documents over 300 times. Moreover, “e-learning” occurred more than 200 times. Other popular keywords that appeared more than 100 times were “e-commerce”, “social media”, “perceived risk”, “intention to use”, “e-government”, “higher education”, “attitude”, “user acceptance”, “Internet”, “self-efficacy”, and “theory of planned behaviour”.

**Table 7. Keywords and their Frequency in TAM Research (Source: Authors’ analysis)**

Keywords	Occurrences	Percentage
Technology acceptance model	3669	44.71%
Perceived usefulness	365	4.45%
Trust	319	3.89%
Perceived ease of use	276	3.36%
E-learning	242	2.95%
Adoption	241	2.94%
Structural Equation Modelling	224	2.08%
E-commerce	171	1.84%
Social media	151	1.79%
Perceived risk	148	1.68%
Intention to use	147	1.60%
E-government	138	1.52%
Higher education	131	1.50%
Attitude	125	1.46%
User acceptance	123	1.40%
Behavioural intention	120	1.38%
Internet	115	1.28%
Self-efficacy	113	1.27%
Theory of Planned Behaviour	105	1.23%

## Title analysis

In Figure 5, the thickness of the connecting lines represents the strength of connection of the words that are related, while the size of the nodes indicates the frequency of occurrence of the terms. The use of the same colour indicates that the terms are related and frequently occur together. The examples (e.g., customer acceptance, customer intent, and integrative model) are all related and frequently occur simultaneously. In this study, VOSviewer generated 11 unique colours representing 11 clusters and 242 keywords based on publication titles. The term co-occurrence network shown in Figure 5 illustrates term occurrences in titles with a minimum of 10 occurrences. The paper used a binary counting method which means the Occurrences attribute indicates the number of documents in which a term occurs at least once. In the case of full counting, the Occurrences attribute indicates the total number of occurrences of a term in all documents, and it is unaffected by the frequency with which a term appears in the title of a publication (Van Eck & Waltman, 2014). Figure 5 demonstrates that the word “theory” was the most important keyword in TAM research, serving as a node at the centre of the entire network. In addition, “Internet”, “design”, and “loyalty” were divided into different clusters and appeared as the most frequently occurring terms in the title, indicating that most studies focused on the role of technologies in understanding customer behaviour.



**Figure 5. A network of term co-occurrences focused on title data, visualized using VOSviewer (binary counting)**

## Key Authors and Collaboration in TAM Research

In this section, the physiognomies of scientific collaborations in the study of the TAM model were investigated by looking at the countries that contributed the most publications, and authorship analysis and citation analysis of the major institutions active in TAM research.

### Countries making the greatest contributions to TAM

Table 8 shows the top ten countries where the majority of publications are done using the TAM model. The United States ranked first with 1491 papers (18.16%), followed by Taiwan with 872 papers (10.62%), and China with 754 papers (9.19%). The rest of the country affiliations contributed less than 10% of the total and were distributed globally. We can conclude that TAM plays an important role in different countries.

**Table 8. Countries involved in publications using TAM model (Source: Authors' analysis)**

Country	Number of documents	Percentage
United States	1491	18.16%
Taiwan	872	10.62%
China	754	9.19%
Malaysia	686	8.36%
United Kingdom	475	5.79%
South Korea	431	5.25%
Indonesia	405	4.93%
Australia	340	4.14%
India	305	3.72%
Spain	297	3.62%

### Institutions

Table 9 lists the institutions that are the sources of the majority of publications in this field. At 16.3%, University of North Texas (US), with the status of one of the world's major universities, accounted for 134 publications. The first five institutions after the US are located in southeast Asian countries: institutions from Indonesia, Malaysia, and Taiwan contributed to most of the publications.

**Table 9. Institutions contributed to research using TAM model (Source: Authors' analysis)**

Institutions	Number of documents	Percentage
University of North Texas	134	16.3%
Universiti Teknologi Malaysia	78	10.62%
Universiti Sains Malaysia	72	9.19%
National Cheng Kung University	65	8.36%
Universiti Kebangsaan Malaysia	55	5.79%
National Taiwan Normal University	54	5.25%
Brunel University London	52	4.93%

Institutions	Number of documents	Percentage
Sungkyunkwan University	50	4.14%
Universiti Putra Malaysia	50	3.72%
National Taiwan University of Science and Technology	49	3.62%

## Authorship

The most productive authors that contributed significantly to the research using the TAM model are given in Table 10. With 43 publications, the most influential author is Timothy Teo, affiliated with Murdoch University, Perth, Australia. The second most productive author on TAM was Mostafa Al-Emran, with 29 publications from University Malaysia Pahang, Kuantan, Malaysia. Next in line is Said A. Salloum, a researcher from the University of Sharjah, United Arab Emirates. After the analysis, the Asian countries produced the most productive authors, which meant that TAM applications in developing countries have become popular and applicable.

**Table 10. Active authors contributing to studies using TAM model (Source: Authors' analysis)**

Author	Number of documents	Percentage
Teo, T.	43	0.52%
Al-Emran, M.	29	0.35%
Salloum, S.A.	28	0.34%
Ooi, K.B.	27	0.33%
Park, E.	25	0.30%
Ramayah, T.	25	0.30%
Al-Rahmi, W.M.	24	0.29%
Shin, D.H.	24	0.29%
Dwivedi, Y.K.	20	0.24%
Tan, G.W.H.	16	0.19%
Venkatesh, V.	16	0.19%
Gao, S.	15	0.18%
Arpaci, I.	14	0.17%
García-Peñalvo, F.J.	14	0.17%
Williams, M.D.	14	0.17%
Bazelais, P.	13	0.16%
Chong, A.Y.L.	13	0.16%
Doleck, T.	13	0.16%
Huang, Y.M.	13	0.16%
Kim, K.J.	13	0.16%

Network visualisation was shown using VOSviewer software. Figure 6 displays co-authorship among many authors. Mapping was done using authors' data with at least five documents and five citations. The degree of the relationship between the authors' works is shown in the connecting lines. Same-coloured authors are frequently grouped. For instance, the figure shows that "Teo T." and "Al-Emran M." have a strong link of 35 even though they form

different clusters. From the analysis, “Zhang Y.” appears to have worked closely with authors from around the world.

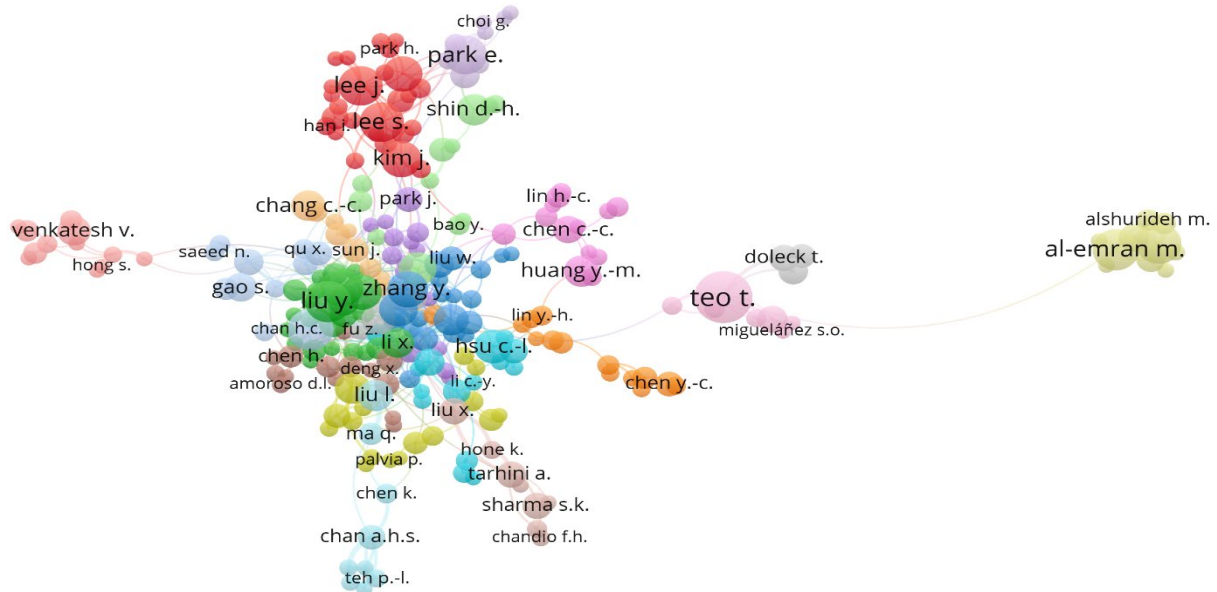


Figure 6. Network visualization map of co-authorship in TAM.

Figure 7 depicts the countries' network visualization map, where countries represent affiliation. The fractional counting approach concluded that US authors play an important role. The US has collaborated closely with Taiwan, Australia, Malaysia, the United Kingdom, and South Korea. Other collaboration activities were set up with colleagues from Spain, India, Germany, and Saudi Arabia.

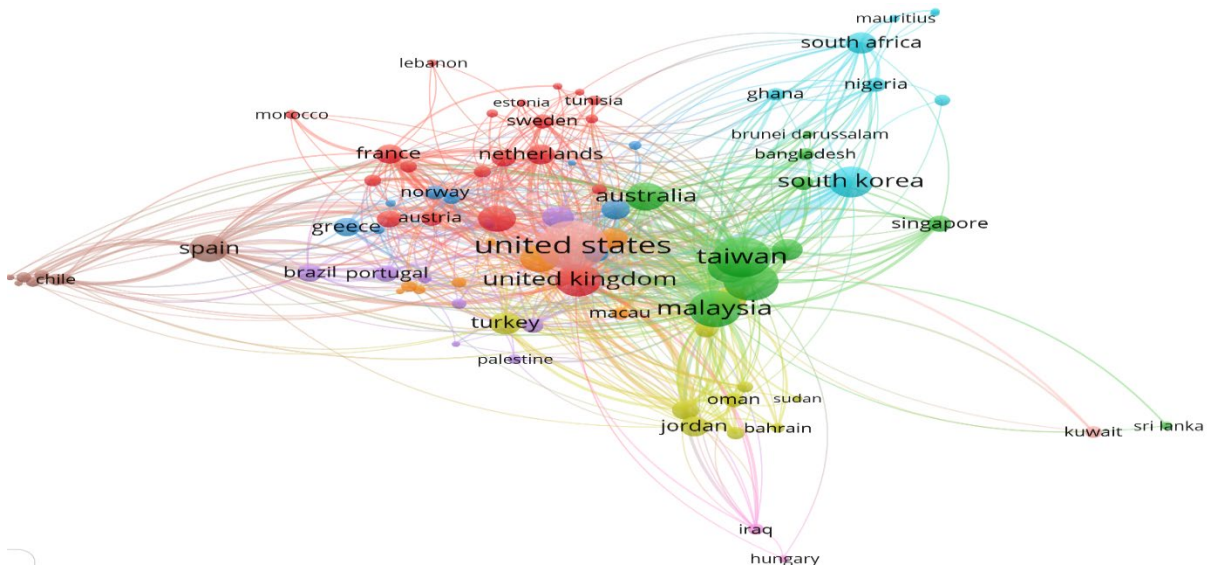


Figure 7. TAM research co-authors' geographical network visualization map



## Citation

Table 11 summarises citation metrics of the published documents retrieved from Scopus. There were 280 632 citations registered for 8207 papers from 1990 to 2021 and an average of 9052.65 citations per year.

**Table 11. Citation Metrics for TAM Research (Source: Authors' analysis)**

<b>Metric</b>	<b>Data</b>
Total papers	8207
Total citations	280632
Number of years	(2021-1990)
Citations per year	9052.65
Citations per paper	32.48
Citations per author	2.92
h-index	209
g-index	428

## Most influential documents

Citation analysis is the most commonly used method for assessing the influence of authors, journals, and documents because it identifies the most important publications in the research field. Table 12 provides an overview of the citation structure in the research area of interest. It is possible to examine which papers are most cited in the field, with the reference publication “User acceptance of information technology: Toward a unified view” by Venkatesh, which has 15518 citations. The document “A theoretical extension of the Technology Acceptance Model: four longitudinal field experiments” by the same author ranks second with 9131 citations. The remaining publications have less than 5000 citations but are still important for TAM technology. Other frequently cited documents included Technology Acceptance Model 3 and User Intentions, as well as those dealing with antecedents of perceived ease of use (PEoU), user acceptance of hedonic information systems, online consumer behaviour, user satisfaction, technological acceptance, and mobile commerce. Moreover, we discovered that the most prominent sources are *MIS Quarterly: Management Information Systems*, *Management Science*, and *Information Systems Research*. Understanding the most cited articles, both historically and on a yearly average, can help researchers identify seminal material that can be used as a reference to support their studies and provide a clear starting point.

Table 12. Most Influential Documents (Source: Authors' analysis)

Author (year)	Title	Source	TC	CPY	CPA
Venkatesh <i>et al.</i> (2003)	User acceptance of information technology: Toward a unified view	MIS Quarterly: Management Information Systems	15518	862.11	3880
Venkatesh & Davis (2000)	A theoretical extension of the Technology Acceptance Model: Four longitudinal field studies	Management Science	9131	434.81	4566
Taylor & Todd (1995b)	Understanding information technology usage: A test of competing models	Information Systems Research	4440	170.77	2220
Bhattacharjee (2001)	Understanding information systems continuance: An expectation-confirmation model	MIS Quarterly: Management Information Systems	3640	182	3640
Venkatesh (2000)	Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model	Information Systems Research	3275	155.95	3275
Venkatesh & Bala (2008)	Technology acceptance model 3 and a research agenda on interventions	Decision Sciences	2681	206.23	1341
Pavlou (2003)	Consumer acceptance of electronic commerce: Integrating trust and risk with the technology acceptance model	International Journal of Electronic Commerce	2662	147.89	2662
Venkatesh & Morris (2000)	Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behaviour	MIS Quarterly: Management Information Systems	2332	111.05	1166
Mathieson (1991)	Predicting user intentions: Comparing the technology acceptance model with the theory of planned behaviour	Information Systems Research	2232	74.4	2232
Davis (1993)	User acceptance of information technology: system characteristics, user perceptions and behavioural impacts	International Journal of Man-Machine Studies	2180	77.86	2180
Legris, Ingham & Colletette (2003)	Why do people use information technology? A critical review of the technology acceptance model	Information and Management	2106	117	702

Author (year)	Title	Source	TC	CPY	CPA
Van Der Heijden (2004)	User acceptance of hedonic information systems	MIS Quarterly: Management Information Systems	2085	122.65	2085
Moon & Kim (2001)	Extending the TAM for a World-Wide-Web context	Information and Management Decision Sciences	2077	103.85	1039
Venkatesh & Davis (1996)	A model of the antecedents of perceived ease of use: Development and test	Information Systems Research	1774	70.96	887
Koufaris (2002)	Applying the Technology Acceptance Model and flow theory to online Consumer Behavior	Information Systems Research	1734	91.26	1734
Agarwal & Prasad (1998)	A Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology	Information Systems Research	1646	71.57	823
Wixom & Todd (2005)	A theoretical integration of user satisfaction and technology acceptance	Information Systems Research	1579	98.69	790
Taylor & Todd (1995c)	Assessing IT usage: The role of prior experience	MIS Quarterly: Management Information Systems	1489	57.27	745
Pavlou & Fygenon (2006)	Understanding and predicting electronic commerce adoption: An extension of the theory of planned behaviour	MIS Quarterly: Management Information Systems	1483	98.87	742
Wu & Wang (2005)	What drives mobile commerce? An empirical evaluation of the revised technology acceptance model	Information and Management	1318	82.38	659

Note: TC=total citations; CPY=citations per year; CPA=citations per author.

The citation-mapping document, which contains at least 20 references, can be found presented in Figure 8. It illustrates the prominent authors who were working in the field at the time and demonstrates how the authors' ideas were arranged with one another. Figure 9 provides a more in-depth network representation of the documents cited by the countries of origin.

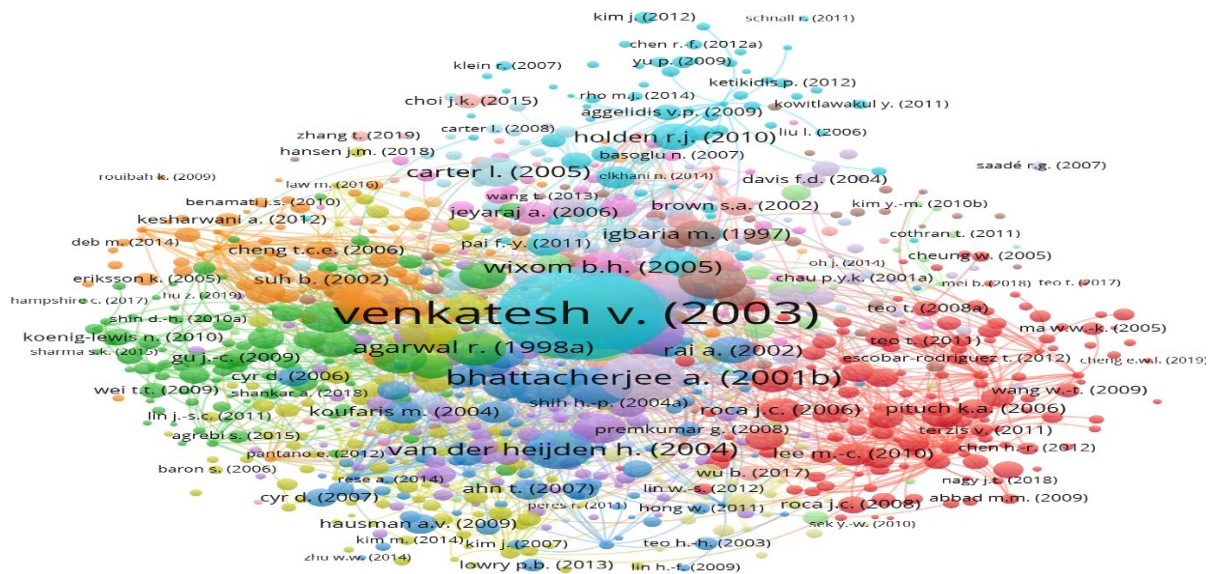


Figure 8. The network visualization map of TAM document citations

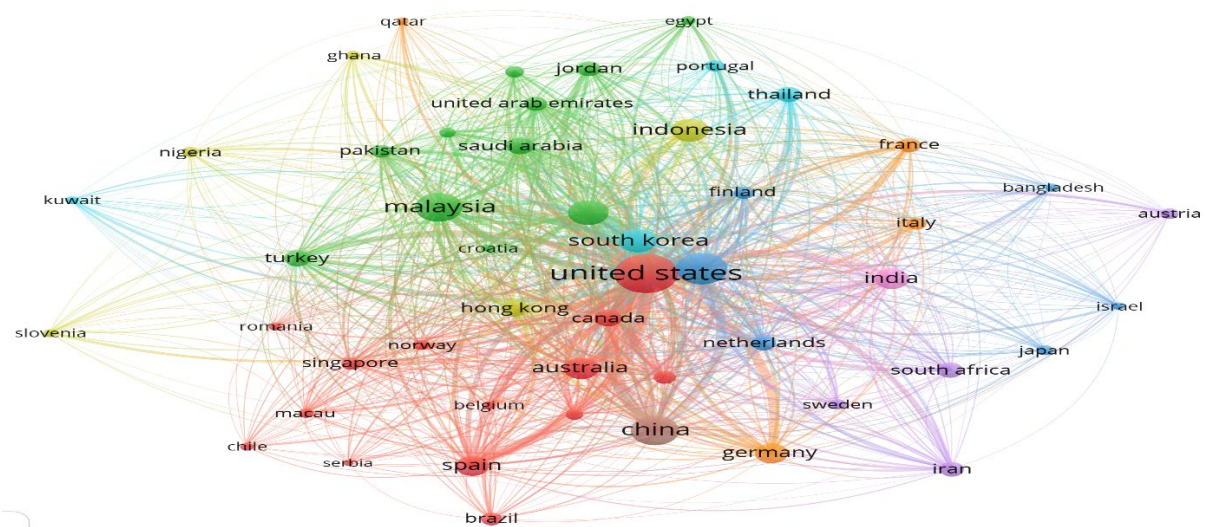


Figure 9. The network visualization map of TAM documents' citations by country

## Discussion

In this study, a bibliometric analysis method is used to analyse research development on TAM. Bibliometric analysis can be used to evaluate the productivity of research and publications in a given field. The results of the bibliometric analysis can reveal the performance and influence of the analyzed research area, which can help managers and policymakers make critical decisions before engaging in the specific area. In addition, the results of the bibliometric study can help academics develop current and relevant research by identifying critical areas that need attention (Abbas *et al.*, 2022; Alsharif *et al.*, 2022).

The concept of perceived ease of use (PEoU) and the concept of perceived usefulness (PU) were developed as two fundamental principles for envisaging user acceptance (Venkatesh *et al.*, 2003). Both discuss an individual's perception towards the usage of new technology, but with a different intention. The first concept highlights effortless usage of technology, whereas

the second concept defines the usage that will improve one's performance. Over the last three decades, there has been a significant increase in the number and variety of theoretical views that have been developed to provide knowledge of usage factors. At the same time, the majority of TAM research focuses on methods for determining the behavioural intentions of an individual. There is a growing need to have a better understanding of the factors that modify the interactions that take place between the TAM variables.

This study aims to identify and understand TAM from a holistic view, making it more valuable because there has never been a study conducted that has conducted a bibliometric review for TAM from 1990 to 2020. Moreover, the study realises that new papers are still increasing and hints at the elevated intention to use TAM to understand user adoption of technology. The selection of 8207 articles for this bibliometric analysis was published within the last 31 years. The study reveals intriguing and stimulating results that are considered important for TAM.

Regarding RQ1, which is concerned with the evolution and distribution of TAM, our results revealed that documents on TAM were first shown in 1991, just briefly after Mathieson coined the abbreviation TAM. The number of documents on TAM continued to grow steadily for the next 30 years after that. The first two papers on TAM were published in the *Journal of Information Systems Research*, and both were from the United States. This demonstrates that researchers from both the East and the West were aware of TAM's existence during the early stages of development.

Most TAM research can be found in journals and conference proceedings as research articles or a conference paper, with a few exceptions published as conference review (0.62%), review (2%), and editorial (0.09%), which accounts for a negligible percentage. The documents were most frequently seen in titles, abstracts, and keywords in computer science and social science. From a country's perspective, the major origin of publication in the area was the United States (from the West), and most of the countries from the East were China, Taiwan, and Malaysia.

Studies in TAM mostly focus on computer and social science, business, management, and accounting, which answers RQ2. The clustering of TAM research showed 11 clusters. It suggests that most TAM research focused on perceived usefulness, trust, ease of use, e-learning, adoption, e-commerce, and social media.

Since 2006, the research trend has shifted from TAM to mobile applications. For example, the study by Hong, Thong & Tam (2006) ushered in an era of mobile commerce/service from the perspective of lower-end consumers. Similarly, Hong *et al.* (2008) studied mobile data services. On the other hand, the study by Liao, Tsou & Huang (2007) examined the variables affecting the use of 3G mobile services. In 2009, the development of 3G mobile value-added services was studied by Kuo & Yen (2009). Aldás-Manzano, Ruiz-Mafé & Sanz-Blas (2009)

studied the variables affecting shoppers' participation in mobile shopping. This stream created a platform for mobile-based TAM research before converging in the node of Zhou, Lu & Wang (2010), who further developed a task-technological-fit (TTF) model and UTAUT integration to propose a model for user acceptance of mobile banking. Following the mobile-based research line of TAM, two recent articles used neural networks (a nonlinear and no compensatory model) and UTAUT (Chong *et al.*, 2012; Williams *et al.*, 2011) to examine factors that influence consumers' propensity to use 3G. The other two nodes in the tail of the network proposed NFC (Near Field Communication), a more specialised and modern application of mobile commerce (Tang, Aik & Choong, 2021). Gender, age, experience, and usage were included as moderator variables in the study by Leong *et al.* (2013), which examined factors influencing the adoption of NFC-enabled mobile credit cards. The study by Tan *et al.* (2014) examined TAM and four other factors to investigate how mobile credit cards (also known as NFC) are adopted.

Further, in terms of RQ3, our examination of countries, institutions, authors, and citations revealed that there appeared to be a good degree of scientific collaboration on TAM research taking place all around the world. While the TAM model has appeared in the USA, Taiwan and China have emerged as the two leading nations from which scholarly articles on TAM are published. The United States had the most TAM articles, indicating that it had been a leader in TAM research for the last 31 years and had possibly directed resources to it. The United States has had the world's top university contributing to TAM up to this point.

## Conclusion

In practice, the paper has significant implications for academics and practitioners to evaluate various techniques to enhance their understanding of TAM as a realistic model. In addition, researchers should attempt to include more constructs, like cognitive absorption and social presence, in TAM, since they have become more important to evolving technology and the current circumstances. The assimilation of theories of acceptance from other disciplines with TAM will be effective, as it will give insights into future technological evaluations applied to other settings for further developments in the prediction of user behaviour. Although significant effort has been observed in research, application and practice still have tremendous potential in this field.

A bibliometric study between the years 1990 and 2020 was carried out in order to compile a comprehensive overview of publications that are pertinent to TAM research. In this paper, the development of TAM is documented through several published studies per year, sources, languages, subject areas, keywords, document names, contributing countries, major institutions, authorship, and citations. Additionally, this paper includes a list of authors. The

findings indicate that early TAM research has continued to thrive and has been widely disseminated ever since it was first conducted. Despite this, the vast majority of TAM research has been focused on the fields of computer science, social science, business, management, and accounting.

Although TAM has proven to be a powerful model that can be applied to a variety of technologies and situations, the study revealed that many studies on technology and innovation adoption were published at the individual level. Moreover, the studies are still increasing during COVID-19, which means there is a huge tendency for users to adopt new technology and innovation.

The Scopus database and keywords found in document titles and abstracts were used exclusively in this study. No other databases, such as Google Scholar, have been taken into account. Extending text analysis tools to include abstracts would very certainly provide new frequencies and new information. Furthermore, multiple names were registered by some authors or institutions or provided alternative spellings in Scopus, resulting in erroneous information about authors' associations or output. In this study, we chose titles, abstracts, and keywords that produced an overall result in TAM. Hence, future studies could focus more on determining the search string by using title only; this will give fewer results and more focus on TAM research.

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