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Technology Acceptance Models and Theories in Library and Information Science Research

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Abstract

There is a growing interest of studying technology implementation, acceptance, and adoption as there are a lot of new innovations regarding potential technologies that can be implemented in information institutions. This study tries to explore the application of theories and models of acceptance models in library and information science research. This study employs a systematic literature review to discuss the historical development of theories and models of technological acceptance and their potential use in the library and information science research. Models and theories of acceptance models have been continuously developed to accommodate reasons explaining users would accept and adopt new systems and technologies. Through this study, we understand that the technology acceptance models and theories are useful to understand how users perceive the new technology and information systems. Through acceptance models and theories, we can formulate reasons the tendency towards either acceptance or rejection of new systems and technologies. Acceptance models and theories are highly relevant in information science to understand issues of the acceptance of the new technologies and systems in information institutions.

Keywords: Technology Acceptance Models, Library and information science

Introduction

Library and information sciences is a broad multidisciplinary field that deal with a lot of issues that is focusing information as a focal interest. A lot of research in library and information sciences had taken different approaches and used different theories to explore information studies (Mckechnie & Pettigrew, 2001). There are significant part of library and information science research that studying in information technology and information systems area (Kim & Jeong, 2006; Mckechnie & Pettigrew, 2001). Previous library and information science research discuss information from different perspectives, such as information as contents, information behavior, information society, information processing, and information technology and systems.

As technology not only influence on the information media, but also user behaviors, it is important to how can technology acceptance models and theories fit in library and information science research. There are various of models and frameworks developed to understand the technology acceptance and adoption by users. These models introduce factors and variables to identify the technology acceptance by users. Technology acceptance is important in the digital age as today, where people are common to interact and use the technology and information systems. It is common problem that there are likely be resistance by its users when a new system is being proposed or implemented. There are reasons why users accept or reject technology. We can use the models to measure and investigate the degree of technology acceptance by the users. One of the models to measure the technology acceptance is Technology Acceptance Model (TAM).

TAM is an information systems theory that models how users come to accept and use a technology (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989). TAM enables prediction of users' acceptance towards technology based on the measurement of their intentions and the

ability their intention regarding their attitudes, subjective norms, perceived usefulness, perceived ease of use, and related variables. TAM was first introduced by Davis (1986) through his dissertation. In his dissertation, Davis (1986) proposed several models of TAM, which is based on TRA (Theory of Reasoned Action). However, the final model of TAM version 1 is widely known by public in 1989 (Davis, 1989; Davis et al., 1989). TAM's main objective is to understand the motivation of users in using specific technologies. There are total of three versions of TAM developed by collaboratively other scientists. Besides TAM, there is another theory of UTAUT (Unified Theory of Acceptance and Use of Technology), which is based on TAM.

TAM and other acceptance models has been used in many studies and research related to user acceptance evaluation on the use of computer-based information systems. Those studies are not only in computer or engineering, but also in some multidisciplinary fields, including library and information science field. In recent years, there is a study of implementation of drone technology as a library services (Nath, 2018). There are also implementation of new technologies and services in the library and information institutions, such as Internet of Things and virtual reality (Aharony, 2013; Baker & Evans, 2017; UNESCO, 2016; Wójcik, 2016).

There will always be innovation and new technologies and information systems being developed. The most important thing is how the users and human actors will perceive and accept the new technologies and information systems to the institution, in this case library and information institutions. Therefore, it is important to address the relevancies of the acceptance models and theories in information sciences. This study tries to explore acceptance models can fit in library and information sciences research and studies.

Literature Review

Development of Technology Acceptance Models and Theories

TAM is first introduced by Davis (1986) as his dissertation at the Sloan School of Management, M.I.T. in 1986 and supervised by John C. Henderson, a professor in Management Science. The final version of TAM gained publicity through a paper by Davis (1989) when he works at the University of Michigan. However, the visualization of the first version of TAM model is made available in Davis, Bagozzi, and Warshaw's (1989) study. TAM is developed through the adaptation of TRA. TRA is firstly developed by Fishbein and Ajzen in 1975 (Davis et al., 1989). Davis, Bagozzi, and Warshaw (1992) further studied both the extrinsic and intrinsic motivations of users in the workplace using two main variables: perceived usefulness (in TAM) and perceived output quality.

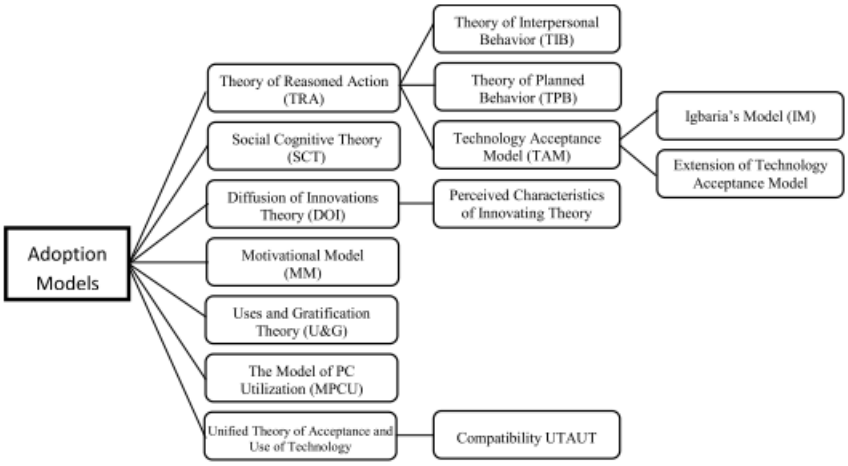


Figure 1.
Adoption Models (Taherdoost, 2018, p. 962)

A study by Taherdoost (2018) explains more comprehensive details of the development of technology acceptance theories and models, including TAM. Figure 1 shows the various models of adoption models. We can see from Figure 1 that TAM is developed based on the TRA (Davis et al., 1989; Taherdoost, 2018). TRA is firstly developed in 1975 by Fishbein and Azjen that are tending to be used in sociological and psychological research. This part explains the development of TAM from its initial phase to TAM 3 and the correlation of TAM with other models.

TAM is further developed to version 2 and version 3 in collaboration with other researchers. In 2000, 11 years after the TAM 1 developed, Davis and Venkatesh developed the Extended TAM or known as TAM 2 (Venkatesh, 2000; Venkatesh & Davis, 2000). In 2008, Venkatesh and Bala (2008) published a paper on the development of TAM 3.

These are the list of researchers involved in the development of TAM:

- Fred D. Davis (Initiator, Version 1 and 2)
- Richard P. Bagozzi (Version 1)
- Paul R. Warshaw (Version 1)
- Viswanath Venkatesh (Version 2 and 3)
- Hillol Bala (Version 3)

Initial Studies on Acceptance Models

The initiation of TAM served to meet two main objectives (Davis, 1986, p. 7). The first objective was to understand the user acceptance processes, providing new theoretical insight into the successful design and implementation of information systems. Another objective is related to the theoretical basis for a practical "user acceptance testing" methodology to enable system designers to evaluate the proposed new systems before it is being implemented. His result model would involve demonstrating system prototype to the potential users and measuring their motivation to use the systems. This model would have resulted in the relative likelihood of success of proposed systems in early phase of their development.

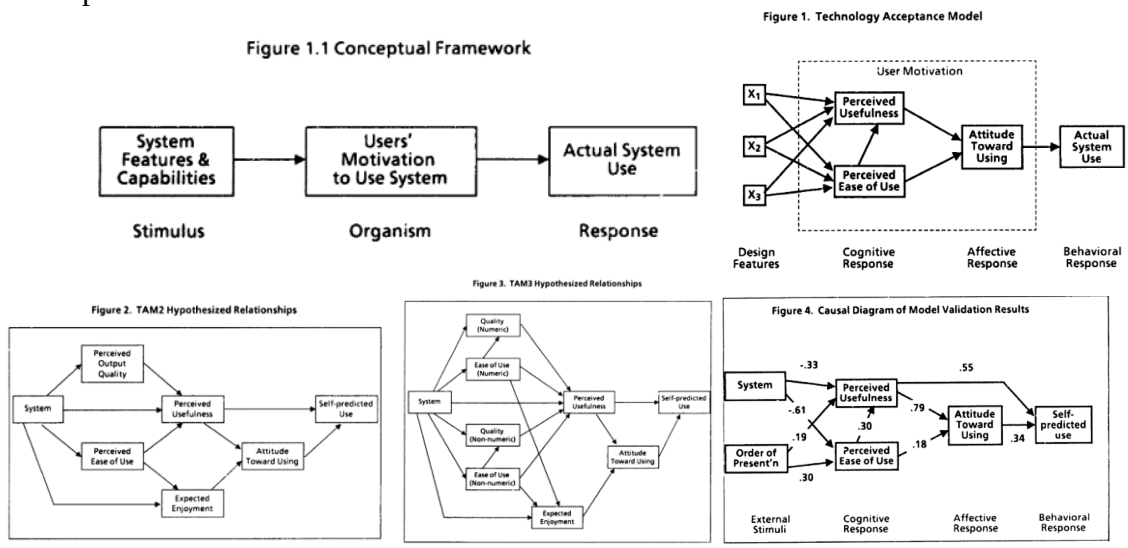


Figure 2.

Several Original Proposed Technology Acceptance Models (Davis, 1986, pp. 10, 24, 137, 143, 195)

Davis (1986, pp. 2–3) conducted several steps in his dissertation:

- A formulation of proposed technology acceptance model was initiated through a theoretical model of human behavior from psychology paradigm.

- Adaptation to make the model applicable to the context of user acceptance of technology.
- Taking empirical support from literature review in the fields of Management Information Systems (MIS) and Human Factors.
- Pretest the model's psychological variables.
- Survey of 100 organizational users to validate the measurements of model's variables.
- A laboratory experiment of 2 systems involved 40 MBA students.
  In his dissertation, Davis proposed several models as presented in Figure 2.

TAM

In 1989, Davis published a paper about user acceptance (Davis, 1989). The research is funded by MIT Sloan School of Management, IBM Canada Ltd. And the University of Michigan Business School. TAM explains the motivation of users by the three main factors; perceived usefulness, perceived ease of use, and attitude toward use. Davis used theories on: self-efficacy theory by Bandura, Cost-Benefit paradigm from behavioral decision theory, Evaluation of Information Reports, Channel Disposition Model and other studies, such as Marketing and Human-Computer Interaction (HCI). This study finalized the first version of TAM (simplified as TAM) (Davis, 1989; Davis et al., 1989). The overview of TAM is presented in the Figure 3, showing interconnected variables that should be considered when a technology being used. TAM is useful for those who interested in the interaction between users and information systems that is still in the development phase that can lead to the users' adoption.

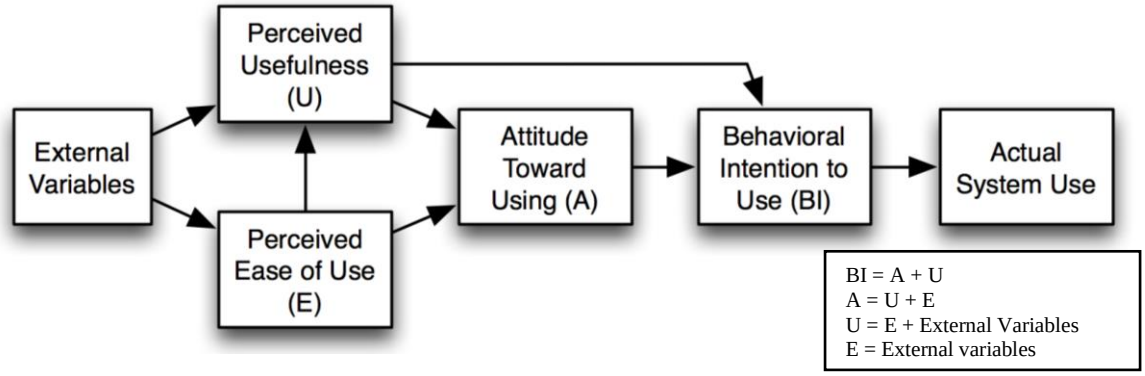


Figure 3.
TAM (Davis, 1989; Davis et al., 1989, p. 985)

As presented in Figure 3, perceived usefulness and ease of use impacting the attitude of the user. The attitude toward using shows the degree of favorable or unfavorable toward the technology/information systems.

> *"Perceived usefulness is the degree to which an individual believes that using a particular system would enhance his or her job performance. Perceived ease of use is the degree to which an individual believes that using a particular system would be free of physical and mental effort."* (Davis, 1986)

TAM also measure the external variables (user training, system characteristics, user participation in design and the implementation process nature). TAM ignored the social influence on adoption of technology, of which limiting the scope of the implementation at a specific case (Taherdoost, 2018, pp. 962–963).

TAM has been developed further to Igbaria's Model (IM) and TAM 2 or Extension of Technology Acceptance Model (ETAM) (Taherdoost, 2018). In 2008, there was a

development of TAM 3, which is developed through study by Venkatesh and Bala (2008) and not involving the original initiator, Fred H. Davis.

TAM 2 or Extended Technology Acceptance Model (ETAM)

In 2000, Davis and Venkatesh developed the Extended TAM or known as TAM 2 (Venkatesh, 2000; Venkatesh & Davis, 2000). There are additional factors that are previously not included in TAM. These new factors are added to the TAM 2 to enhance "adaptively, explanatory power and specificity" (Taherdoost, 2018). The addition of these factors offering enhancement to its adaptability, explanatory, and specification. There are two types of studies in ETAM or TAM 2. The first study is focused on the antecedents of perceived usefulness and BI (known as TAM 2 or TAM 2 Type 1) The second study focused on the influence on perceived ease of use (TAM 2 Type 2).

The type 1 of TAM 2 focused on "Perceived Usefulness" by adding several variables, including Subjective Norm, Image, Job Relevance, Output Quality, and Result Demonstrability (Venkatesh & Davis, 2000). TAM 2 Type 1 is presented on Figure 4.

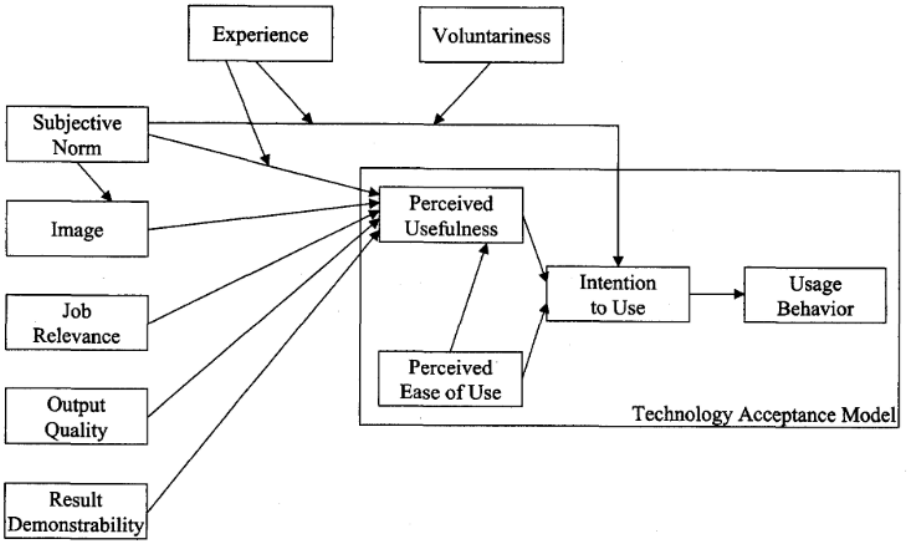


Figure 4.

TAM 2 Type 1 (Venkatesh & Davis, 2000, p. 188)

In Type 2, Venkatesh (2000) focused on Perceived Ease of Use by adding several factors, including Anchors (Computer Self-Efficacy, Perceptions of External Control, Computer Anxiety, and Computer Playfulness) and Adjustment (Perceived Enjoyment and Objective Usability). TAM 2 Type 2 is presented on Figure 5.

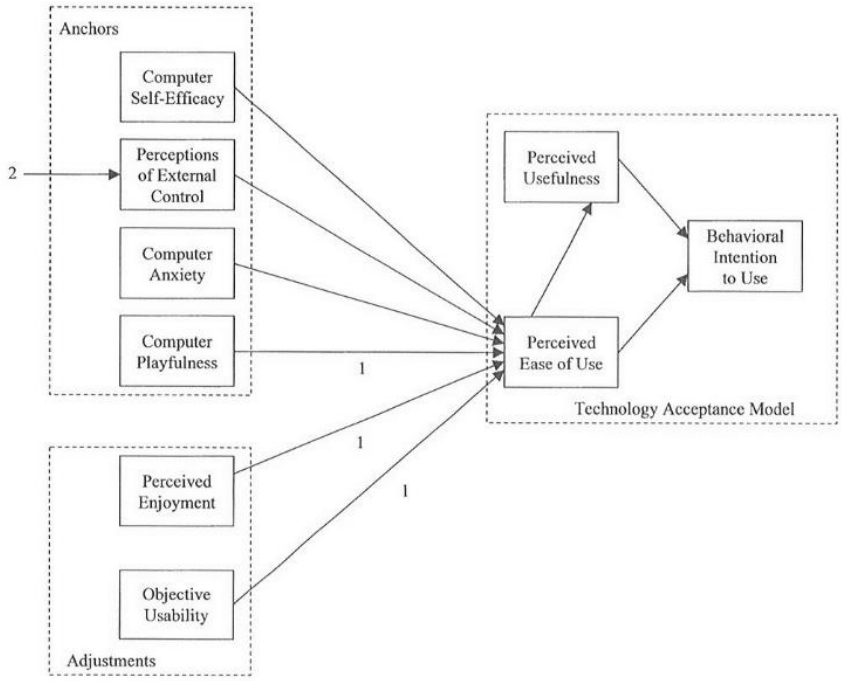


Figure 5.
TAM 2 Type 2 (Venkatesh, 2000, p. 346)

TAM 3

In 2008, TAM 3 was developed. TAM 3 added several factors: Individual Differences, System Characteristics, Social Influence, and Facilitating Conditions (Venkatesh & Bala, 2008). TAM 3 is combination of TAM 2 Type 1 and TAM 2 Type 2. TAM 3 is presented on Figure 6.

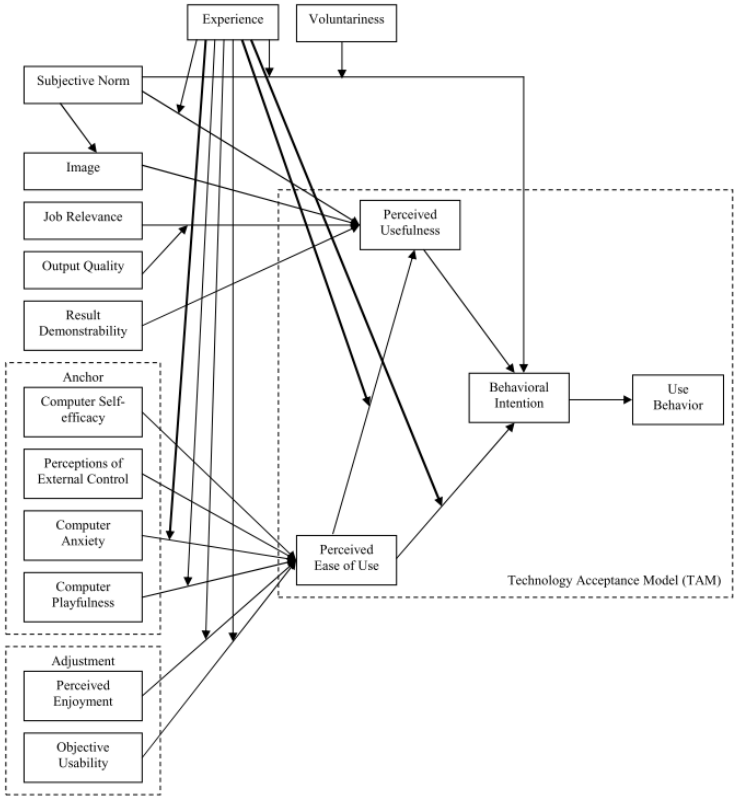


Figure 6.
TAM 3 (Venkatesh & Bala, 2008, p. 276)

TAM and Other Acceptance Models

A Study by Momani and Jamous (2017) explains the development of Technology Acceptance by reviewing 10 technology acceptance theories and models: TRA, Theory of Planned Behavior (TPB), Decomposed Theory of Planned Bevior (DTPB), TAM, TAM2, Combined TAM and TPB, Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT/Diffusion of Innovation (DOI)), The Motivational Model (MM), and Social Cognitive Theory (SCT). According to them, development of TAM comes through three phases: adoption, validation, and extension. In the adoption phase, TAM was tested in a huge number of Information Systems. In the validation phase, there was measurement of users' acceptance behavior. In the extension phase, there was additional variables in the TAM's constructs. Momani and Jamous further explain that TAM has limitations: does not provide feedback on some factors that may enhance the adoption, such as integration, flexibility, completeness of information, and information currency. TAM also does not specify how the expectations influencing behavior. TAM also cannot be used for predicting user behavior in a specific culture.

In 1996, before TAM 2 came into existence, IM (Igbaria's Model) is developed by adding explanation on extrinsic (perceived usefulness) and intrinsic motivators (fun) effecting on the acceptance or rejection of the new technology (Taherdoost, 2018). In IM, user acceptance is affected both directly and indirectly by perceived usefulness, computer anxiety, computer satisfaction, and perceived fun.

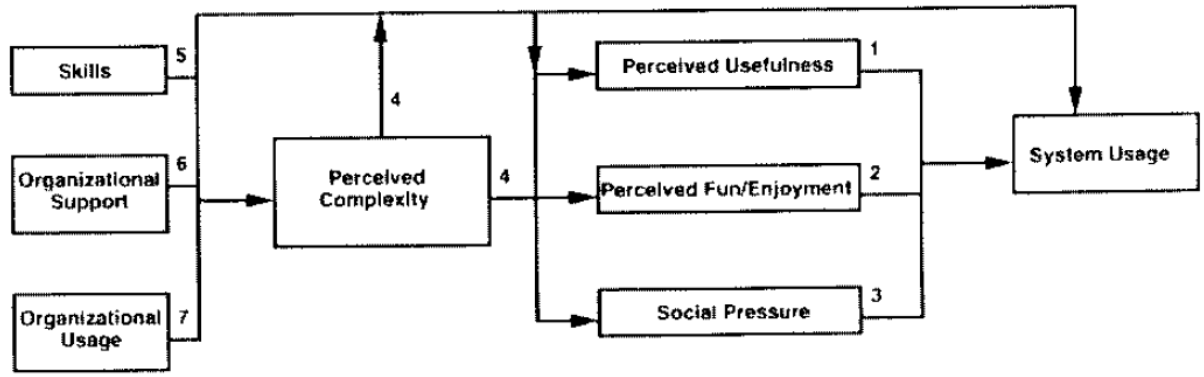


Figure 7.

Igbaria's Motivational Model of Microcomputer Usage (Igbaria, Parasuraman, & Baroudi, 1996, p. 130)

In 2003, before TAM 3 exists, TAM is developed further to a unified model, called UTAUT (Unified Theory of Acceptance and Use of Technology) (Venkatesh, Morris, Davis, & Davis, 2003). TAM is also closely related to Diffusion of Innovation (DOI), where both of them share similarities (Taherdoost, 2018). Similar to Diffusion of Innovation (DOI), TAM also adopts a unidirectional perspective towards causal relationship. Both TAM and DOI focus solely on beliefs about the technology. Both DOI and TAM have overlapping factors, such as complexity and perceived ease of use, relative advantage and perceived usefulness. The models of UTAUT, TAM, DOI are used commonly in the field of information management.

Discussion

How to Use of Technology Acceptance Model

In the initial publication, Davis (1989) applying mixed research approach, applying experiment studies using survey and interviews of questions and scaling answers of two main important variables of TAM: perceived usefulness and perceived ease of use. Both factors can lead to attitude toward using the technology. Perceived usefulness refers to the

prospective user's subjective probability that using application system will increase his or her job performance within an organizational context. Perceived ease of use is defined as the degree to which the prospective user expects the target systems to be free of effort. In all TAMs, correlation analysis, Structural Equation Modelling, and factor analysis is done to see how one factor correlate and contribute to other factors in the defined models.

TAM Research Model

These are the questions need to be asked when using TAM as the research model:

Perceived Usefulness

- Using <name of technology/IS> in my job would enable me to accomplish.
- Using <name of technology/IS> would improve my job performance.
- Using <name of technology/IS> in my job would increase my productivity.
- Using <name of technology/IS> would enhance my effectiveness on the job.
- Using <name of technology/IS> would make it easier to do my job.
- I would find <name of technology/IS> useful in my job.

Perceived Ease of Use

- Learning to operate <name of technology/IS> would be easy for me.
- I would find it easy to get <name of technology/IS> to do what I want it to do.
- My interaction with <name of technology/IS> would be clear and understandable.
- I would find <name of technology/IS> to be flexible to interact with.
- It would be easy for me to become skillful at using <name of technology/IS>.
- I would find <name of technology/IS> easy to use.

Table 1.

Scale Items of TAM (Davis, 1989, p. 326)

Usefulness	Ease of Use
1. Job Difficult Without	1. Confusing
2. Control over Work	2. Error Prone
3. Job Performance	3. Frustrating
4. Addresses My Needs	4. Dependence on Manual
5. Saves Me Time	5. Mental Effort
6. Work More Quickly	6. Error Recovery
7. Critical to My Job	7. Rigid & Inflexible
8. Accomplish More Work	8. Controllable
9. Cut Unproductive Time	9. Unexpected Behavior
10. Effectiveness	10. Cumbersome
11. Quality of Work	11. Understandable
12. Increase Productivity	12. Ease of Remembering
13. Makes Job Easier	13. Provides Guidance
14. Useful	14. Easy to Use
	15. Ease of Learning
	16. Effort to Become Skillful

In Davis (1989) study, interviews were also been used. Interviewees are asked to list advantages, disadvantages, and other things associated with a technology/IS. Correlation analysis

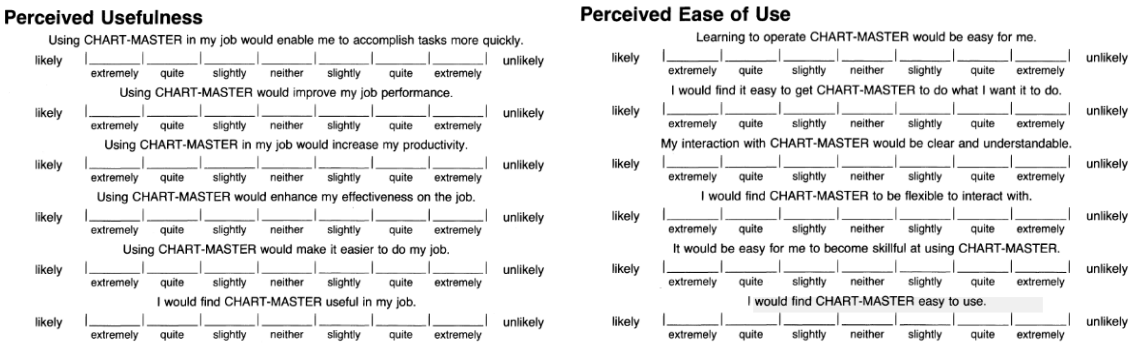


Figure 8.
Survey on TAM (Davis, 1989, p. 340)

TAM 2 Research Model

There are two versions of TAM 2. Type 1, which is adding social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use) (Venkatesh & Davis, 2000). Type 2 is more focused on perceived ease of use, adding control (internal or self-efficacy and external or facilitating conditions), intrinsic motivation (computer playfulness), and emotion (computer anxiety) (Venkatesh, 2000). Both studies focused on survey of variables using a Likert scale answer. The surveys on TAM 2 are presented in Figure 9 and Figure 10.

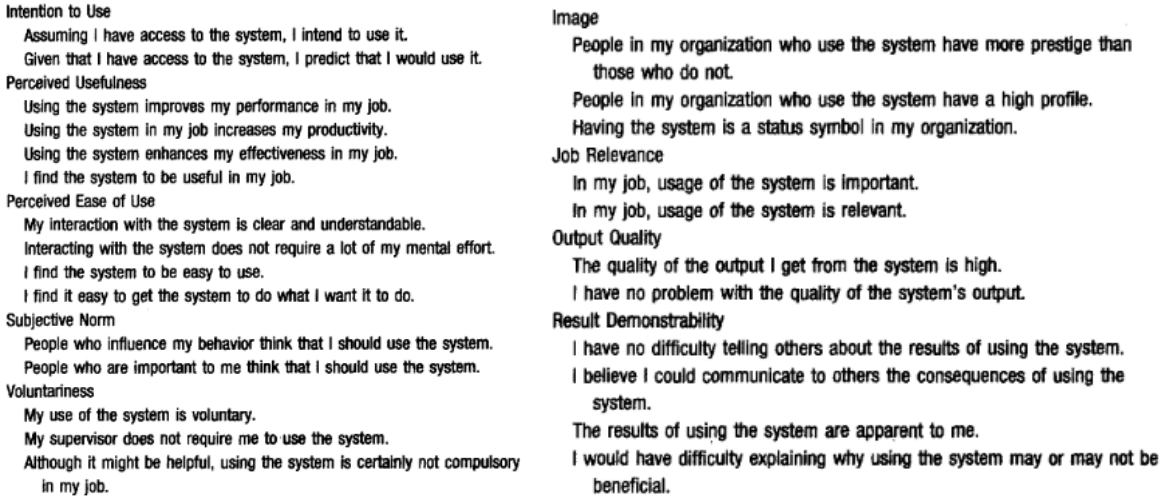
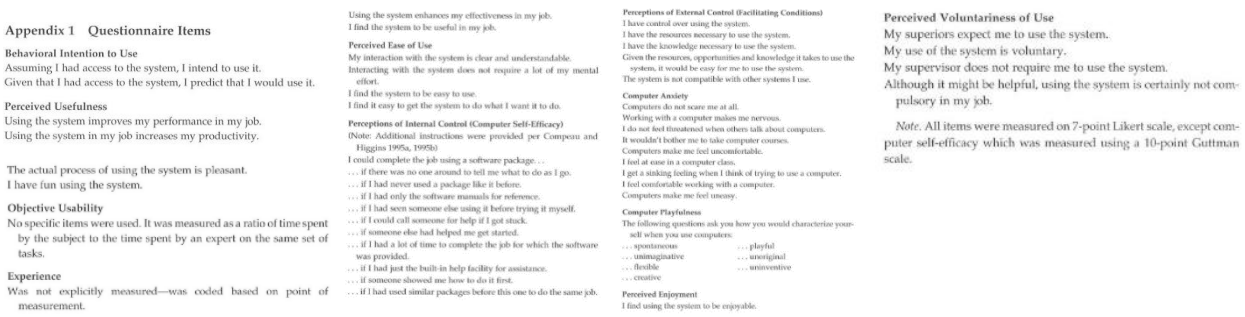


Figure 9.
Survey on TAM 2 Type 1 (Venkatesh & Davis, 2000, p. 201).


Appendix 1 Questionnaire Items

Behavioral Intention to Use
Assuming I had access to the system, I intend to use it.
Given that I had access to the system, I predict that I would use it.

Perceived Usefulness
Using the system improves my performance in my job.
Using the system in my job increases my productivity.

The actual process of using the system is pleasant.
I have fun using the system.

Objective Usability
No specific items were used. It was measured as a ratio of time spent by the subject to the time spent by an expert on the same set of tasks.

Experience
Was not explicitly measured—was coded based on point of measurement.

Using the system enhances my effectiveness in my job.
I find the system to be useful in my job.

Perceived Ease of Use
My interaction with the system is clear and understandable.
Interacting with the system does not require a lot of my mental effort.
I find the system to be easy to use.
I find it easy to get the system to do what I want it to do.

Perceptions of Internal Control (Computer Self-Efficacy)
(Note: Additional instructions were provided per Compeau and Higgins 1995a, 1995b)
I could complete the job using a software package . . .
. . . if there was no one around to tell me what to do as I go.
. . . if I had never used a package like it before.
. . . if I had only the software manuals for reference.
. . . if I had seen someone else using it before trying it myself.
. . . if I could call someone for help if I got stuck.
. . . if someone else had helped me get started.
. . . if I had a lot of time to complete the job for which the software was provided.
. . . if I had just the built-in help facility for assistance.
. . . if someone showed me how to do it first.
. . . if I had used similar packages before this one to do the same job.

Perceptions of External Control (Facilitating Conditions)
I have control over using the system.
I have the resources necessary to use the system.
I have the knowledge necessary to use the system.
Given the resources, opportunities and knowledge it takes to use the system, it would be easy for me to use the system.
The system is not compatible with other systems I use.

Computer Anxiety
Computers do not scare me at all.
Working with a computer makes me nervous.
I do not feel threatened when others talk about computers.
It wouldn't bother me to take computer courses.
Computers make me feel uncomfortable.
I feel at ease in a computer class.
I get a sinking feeling when I think of trying to use a computer.
I feel comfortable working with a computer.
Computers make me feel uneasy.

Computer Playfulness
The following questions ask you how you would characterize yourself when you use computers:
. . . spontaneous
. . . playful
. . . unimaginative
. . . unoriginal
. . . flexible
. . . uninventive
. . . creative

Perceived Enjoyment
I find using the system to be enjoyable.

Perceived Voluntariness of Use
My superiors expect me to use the system.
My use of the system is voluntary.
My supervisor does not require me to use the system.
Although it might be helpful, using the system is certainly not compulsory in my job.

Note. All items were measured on 7-point Likert scale, except computer self-efficacy which was measured using a 10-point Guttman scale.

Figure 10.
Survey on TAM 2 Type 2 (Venkatesh, 2000, pp. 360–361)

TAM 3 Research Model

TAM 3 is combination of TAM 2 Type 1 and TAM 2 Type 2 (Venkatesh & Bala, 2008). The survey of TAM 3 is presented in Figure 11. The survey is still using Likert Scale answer.

Constructs		Items[a]
Perceived Usefulness (PU)	PU1	Using the system improves my performance in my job.
	PU2	Using the system in my job increases my productivity.
	PU3	Using the system enhances my effectiveness in my job.
	PU4	I find the system to be useful in my job.
Perceived Ease of Use (PEOU)	PEOU1	My interaction with the system is clear and understandable.
	PEOU2	Interacting with the system does not require a lot of my mental effort.
	PEOU3	I find the system to be easy to use.
	PEOU4	I find it easy to get the system to do what I want it to do.
Computer Self-Efficacy (CSE)		I could complete the job using a software package . . .
	CSE1	. . . if there was no one around to tell me what to do as I go.
	CSE2	. . . if I had just the built-in help facility for assistance.
	CSE3	. . . if someone showed me how to do it first.
	CSE4	. . . if I had used similar packages before this one to do the same job.
Perceptions of External Control (PEC)	PEC1	I have control over using the system.
	PEC2	I have the resources necessary to use the system.
	PEC3	Given the resources, opportunities and knowledge it takes to use the system, it would be easy for me to use the system.
	PEC4	The system is not compatible with other systems I use.
Computer Playfulness (CPLAY)		The following questions ask you how you would characterize yourself when you use computers:
	CPLAY1	. . . spontaneous
	CPLAY2	. . . creative
	CPLAY3	. . . playful
	CPLAY4	. . . unoriginal
Computer Anxiety (CANX)	CANX1	Computers do not scare me at all.
	CANX2	Working with a computer makes me nervous.
	CANX3	Computers make me feel uncomfortable.
	CANX4	Computers make me feel uneasy.
Perceived Enjoyment (ENJ)	ENJ1	I find using the system to be enjoyable.
	ENJ2	The actual process of using the system is pleasant.
	ENJ3	I have fun using the system.
Objective Usability (OU)		No specific items were used. It was measured as a ratio of time spent by the subject to the time spent by an expert on the same set of tasks.
Subjective Norm (SN)	SN1	People who influence my behavior think that I should use the system.
	SN2	People who are important to me think that I should use the system.
	SN3	The senior management of this business has been helpful in the use of the system.
	SN4	In general, the organization has supported the use of the system.
Voluntariness (VOL)	VOL1	My use of the system is voluntary.
	VOL2	My supervisor does not require me to use the system.
	VOL3	Although it might be helpful, using the system is certainly not compulsory in my job.
Image (IMG)	IMG1	People in my organization who use the system have more prestige than those who do not.
	IMG2	People in my organization who use the system have a high profile.
	IMG3	Having the system is a status symbol in my organization.
Job Relevance (REL)	REL1	In my job, usage of the system is important.
	REL2	In my job, usage of the system is relevant.
	REL3	The use of the system is pertinent to my various job-related tasks.
Output Quality (OUT)	OUT1	The quality of the output I get from the system is high.
	OUT2	I have no problem with the quality of the system's output.
	OUT3	I rate the results from the system to be excellent.
Result Demonstrability (RES)	RES1	I have no difficulty telling others about the results of using the system.
	RES2	I believe I could communicate to others the consequences of using the system.
	RES3	The results of using the system are apparent to me.
	RES4	I would have difficulty explaining why using the system may or may not be beneficial.
Behavioral Intention (BI)	BI1	Assuming I had access to the system, I intend to use it.
	BI2	Given that I had access to the system, I predict that I would use it.
	BI3	I plan to use the system in the next <n> months.
Use (USE)	USE1	On average, how much time do you spend on the system each day?

[a]All items were measured on a 7-point Likert scale (where 1: *strongly disagree*; 2: *moderately disagree*, 3: *somewhat disagree*, 4: *neutral* (neither disagree nor agree), 5: *somewhat agree*, 6: *moderately agree*, and 7: *strongly agree*), except computer self-efficacy, which was measured using a 10-point Guttman scale.

Figure 10.

Survey on TAM 3 (Venkatesh & Bala, 2008, pp. 313–314)

Application of Technology Acceptance Model in Library and Information Science Research

When "technology acceptance model" being used as a query in a database, it will generate a huge amount of literature and studies search results, as shown in Figure 11.

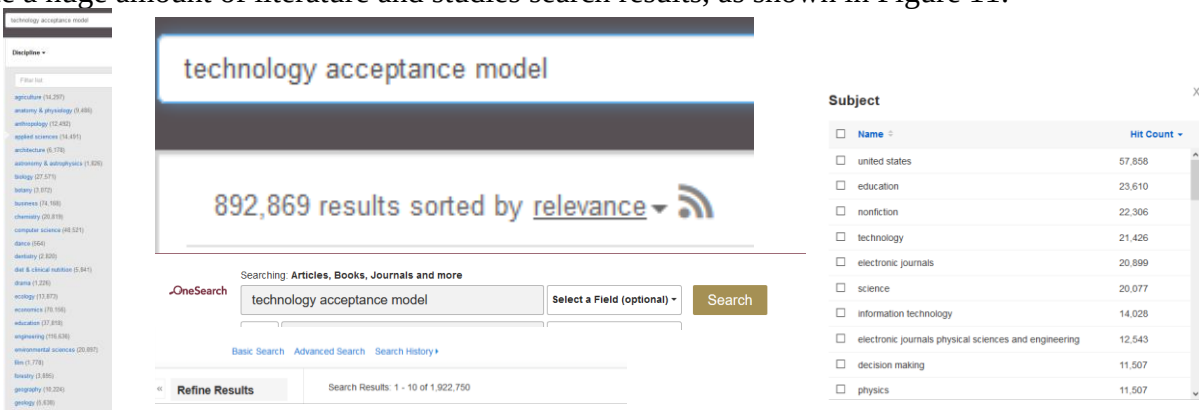


Figure 11.

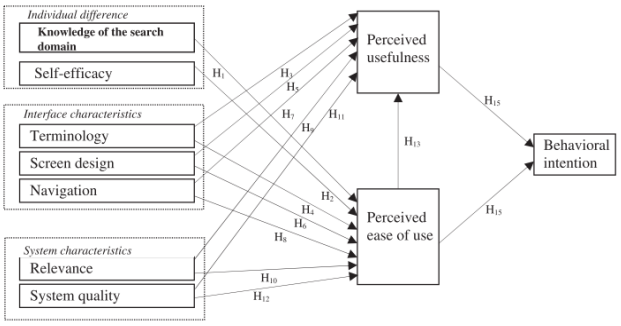
Search Results of "Technology Acceptance Model" Query and Disciplines

As presented in Figure 11, TAM has been used in many studies across various disciplines with many different methodologies. As explained in previous parts, TAM is used

mostly to understand the degree of adoption of technology or information systems. The original TAM is still being used in many studies.

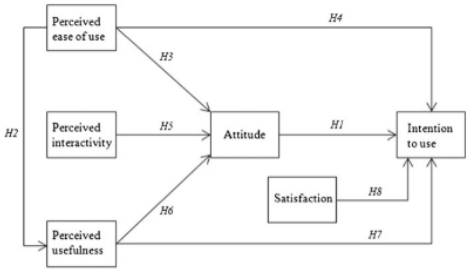
In library and information sciences, there are several studies adopting TAM as their research models. Weerasinghe and Hindagolla (2017) conducted a literature review on TAM in the domains of LIS and education. Park, Roman, Lee, and Chung (2009) explains TAM in the implementation of digital library systems in developing countries. There are several authors, who used TAM to measure the adoption of mobile services in libraries (Abdekhoda, Gholami, & Zarea, 2018; Aharony, 2013; Vonjaturapat & Chaveesuk, 2013; Yoon, 2016). Several studies used TAM as the model in digital reference and digital libraries (Jeong, 2011; Khan, Masrek, Mahmood, & Qutab, 2017). Another study is discussing adoption of social media by library using TAM (Mabweazara & Zinn, 2016).

Most of these studies are usually quantitative and/or mixed method studies. Questionnaire is based on the original model of TAM (Davis, 1989). The example of the study can be seen in Jeong's (2011) and Yoon's (2016) research model that are presented in Figure 12 and Figure 13, where it shows that most of the questionnaire is based on Davis's (1989) study. Both studies also analyzing the survey using Factor analysis and Structured Equation Modelling (SEM) with Partial Least Squares (PLS).



Constructs	Items	Measures	Reference
Perceived ease of use	PEOU1	Learning to use an e-library would be easy for me.	Davis (1989) Venkatesh and
	PEOU2	I find that an e-library is clear and easy to understand.	Davis (1996, 2000)
	PEOU3	It is easy for me to become skilful at using an e-library.	
	PEOU4	I find that an e-library is very easy to use.	
Perceived usefulness	PU1	Using an e-library would improve my learning performance.	Davis (1989) Venkatesh and
	PU2	Using an e-library would enhance my effectiveness in my learning.	Davis (1996, 2000)
	PU3	Using an e-library would increase my learning productivity.	
	PU4	An e-library would be useful in my learning.	
Behavioral intention	BI1	I intend to continue using an e-library in the future.	Davis (1989) Venkatesh and
	BI2	I will continue using an e-library in the future.	Davis (1996, 2000)
	BI3	I will regularly use an e-library in the future.	
	BI4	I intend to increase my use of an e-library in the future.	
Knowledge of search domain	KSOD1	I am familiar with the subject domain that I am searching in the e-library.	Thong et al. (2002)
	KSOD2	I am knowledgeable in the topic that I am searching in the e-library.	
	KOSD3	I have previous experience with an e-library in search domain.	
	KOSD4	I have the domain knowledge that is necessary to search for what I want to find in an e-library.	
Self efficacy	I feel confident in my ability to perform each of the following computer or Internet-related activities:		Compeau et al. (1999 in 29) Murphy et al. (1989 in 29) Hsu and Chiu (2004)
	SE1	Using basic software (e.g., M.S. Word and PowerPoint).	
	SE2	Using the Internet for learning.	
	SE3	Using the Internet for searching information.	
Terminology	TE1	I understand most of the terms that are used throughout the e-library.	Thong et al. (2002)
	TE2	The use of terms throughout the e-library is consistent.	
	TE3	The e-library provides terms that are easy to understand.	
Screen design	SD1	The e-library commands are well depicted by buttons and symbols.	Thong et al. (2002)
	SD2	The layout of the e-library screens is clear and consistent.	Piccoli et al. (2001 in 34)
	SD3	Fonts (style, color, and saturation) are easy to read on-screen.	
Navigation	NA1	It is easy to navigate the e-library site.	Thong et al. (2002)
	NA2	In the e-library, I can easily navigate to where I want.	Piccoli et al. (2001 in 34)
	NA3	The e-library system's directions and navigations are clear.	
Relevance	RE1	The resources in the e-library relate well to my study.	Thong et al. (2002a, 2002b)
	RE2	The e-library has enough resources for my study.	
	RE3	I believe that the e-library is a very efficient study tool.	
System quality	SQ1	I would find it easy to get access to the e-library.	Rivard et al. (1997)
	SQ2	The e-library is accessible 24 h a day, 7 days a week.	Chiu et al. (2009)
	SQ3	The layout and system design of the e-library are friendly.	
	SQ4	I feel comfortable using the functions and services that are provided by the e-library.	

Figure 12.
Research Model on a Study on e-Library Adoption using TAM (Jeong, 2011)



Constructs	Items	Description	Reference
Perceived ease of use	PEOU1	Using mobile library apps does not require much mental effort.	Davis (1989, 1993)
	PEOU2	I find mobile library apps easy to use.	
	PEOU3	I find it easy to access and use mobile library apps when and where I want.	
Perceived interactivity	PI1	Access and response speed of mobile library apps is fast.	Wu (2000),
	PI2	I think mobile library apps' content is useful to me.	Ha and James (1989)
	PI3	It is convenient to use mobile library apps at any time.	
	PI4	It is convenient to use mobile library apps everywhere.	
Perceived usefulness	PU1	I think the mobile library application is useful to me.	Davis (1989, 1993)
	PU2	The mobile library app enables me to use library services more quickly.	
	PU3	I find that mobile library apps save my time.	
Attitude	ATT1	It would be a wonderful idea to use mobile library apps.	Davis (1989, 1993)
	ATT2	I would have positive feelings toward mobile library apps in general.	
	ATT3	It is easier and better for me to use mobile library apps, as compared to a library visit.	
Satisfaction	SA1	Overall, I am satisfied with mobile library apps.	DeLone and McLean (2003),
	SA2	The mobile library application that I am now using meets my expectations.	Park and Kim (2012)
	SA3	The mobile library application is a beneficial tool in improving life.	
Intention to use	IU1	I intend to use mobile library apps as much as possible.	Davis (1989, 1993)
	IU2	I intend to continue using mobile library apps in the future.	
	IU3	I recommend mobile library services to my friends.	

Figure 13.
Research model on a Study of Mobile Application Adoption in a Library using TAM (Yoon, 2016)

An additional interview (indicating mixed method) are usually done to add in-depth analysis to the findings. For example, Weerasinghe and Hindagolla (2017) and Vonjaturapat and Chaveesuk (2013) conducted survey, interviews, and focus groups on their studies. Interviews can enrich the quantitative findings to the study.

In the era of big data and crowdsource platforms, understanding TAM is important. In information institutions, the growing awareness of scholarly communication and data management made them to develop new services and platforms. In many libraries, it is now common for them to adopt Internet of Things (IoT) in their libraries. IoT is the technology enabled by interconnected through networks, where every entities (human and devices) could communicate smoothly whenever needed (Hahn, 2017; Min, 2014; Nolin & Olson, 2016; Wójcik, 2016). The data transmission and communication is so seamlessly done that we are

often not aware that the data are being transmitted and processed real-time. The example of IoT technologies are network transmission interconnection, radio frequency identification (RFID), Bluetooth, sensors, Global Positioning Systems (Min, 2014). The concept of smart library could be achieved with IoT (Min, 2014; Wójcik, 2016). Smart library makes full use of its equipment, sensors, intelligent building, cloud computing that communicates interactively with users' devices to realize what has not been possible by previous technology.

There are several layers of the implementation of IoT in smart library (Min, 2014). The specific layers enable specific types of service to users in libraries. IoT make full use of interconnected devices with a combination of artificial intelligence, real-time control and precise management (Min, 2014). To fully implement IoT, the users, information systems, and devices should be connected to the network. This network auto connecting all of the users with each other, users with infrastructure, and between infrastructures (Massis, 2016; Nolin & Olson, 2016). IoT encompasses the use of many seamless interconnected smart appliances and sensors (Hahn, 2017). IoT could be implemented in the larger area, where several IoTs are connected to each other to understand how the data could be generated in the larger scope. All interconnected devices in IoT have autonomous ways of submitting and receiving data to other devices.

As discussed earlier, TAM measuring variables: Perceived Usefulness and Perceived Ease of Use and Attitude toward Using the Systems. TAM could be useful in the prediction on adoption or rejection to new technologies, such as IoT. With acceptance models and theories, there could be more studies on the identification of the adoption factors in TAM using factor analysis to understand how information institutions' intentions in the implementation of IoT.

Conclusions

Information Technology and Information Systems becomes massively available and advanced rapidly that draws a lot of attentions to library and information science researchers. Acceptance models and theories help researchers to understand how users behave towards technology and systems. Since its initiation until now, acceptance models have evolved into more complex models that covers a lot of variables into it. The complex models and theories of acceptance models represents the complexity to understand user behaviours towards systems and technology. The complexity of interrelated acceptance aspects in the models and theories allow flexibility for researchers to modify and apply in various situation and condition. Researchers can customize the acceptance models according to the research questions they want to answer. Acceptance models and theories have been used in many different areas of research, including library and information science. Acceptance models and theories are relevant to address various issues of systems adoption and acceptance by users. Library and information science researchers can expand their studies through acceptance models and theories.

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