What external factors determine information system adoption? A literature review on the Technology Acceptance Model

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Abstract: The question of why individuals adopt information technology has been present in the information systems research since the past quarter century. One of the most used models for predicting the technology usage was introduced by Fred Davis: The Technology Acceptance Model (TAM). It describes the Influence of Perceived Usefulness and Perceived Ease of Use on Attitude, Behavioral Intention and System Usage. The first two mentioned factors in turn are influenced by external variables. Although a plethora of papers exists about the TAM, an extensive analysis of the role of the external variables in the model is still missing. This paper aims to give an overview over the most important variables. In an extensive literature review, we identified 763 relevant papers, found 552 unique single external variables, characterized the most important of them, and described the frequency of their appearance. Additionally, we grouped these variables into four categories (Organizational Characteristics, System Characteristics, User Personal Characteristics, and Other Variables). Afterwards we discuss the results and show implications for theory and practice.

Keywords: Technology Acceptance Model; Adoption; Literature Review

1   Introduction

Why do people use information systems is one of the most asked questions in information system science. The issue of determining the factors that lead to system usage is an old and continuing question since the emergence of this field [KH06]. Although researchers have been focusing on the integration of information systems in businesses since the seventies [LIC03], the topic remains even important today: It becomes especially relevant when it comes to the introduction of new tools that comprise Social media features in an enterprise context. A large body of research on system adoption in the last decades has shown the interest in models for predicting system usage.

One model that has gained special attention is the so called Technology Acceptance Model (TAM) that was introduced by Fred Davis in his doctoral dissertation in 1985 [Da85]. The TAM is built on the basis of the social-psychological Theory of Reasoned Action (TRA)

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that was formulated by Fishbein and Ajzen in 1975 [FA75]. This theory aims at explaining the behavior of people by focusing on their attitude: the "individual's positive or negative feelings (evaluative effect) about performing the target behavior" [FA75]. Fishbein and Ajzen suggest that a person's attitude influences the behavioral intention which again has an effect on the individuals' behavior [YFP07].

Drawing from this theory, the TAM explains actual user behavior and predicts actual system usage [DBW89]. Although it was created especially to explain computer usage behavior in particular, it soon became clear that the model was capable of making profound statements about a broader range of end-user computing technologies [DBW89]. In general, the goal of the TAM is to shed light on the determinants of system usage of individuals by "tracing the impact of external factors on internal beliefs, attitudes, and intentions" [DBW89]. Figure 1 shows the causal chain used in the TAM.
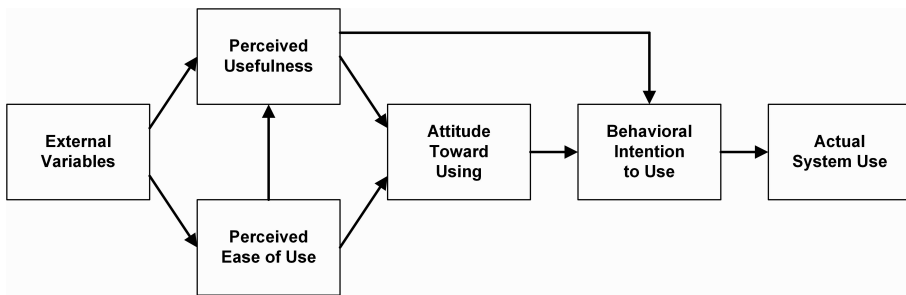

Fig. 1: Technology Acceptance Model [Da85]

Two factors are central to the TAM: the perceived usefulness (PU) and the perceived ease of use (PEOU) [YFP07]. PU describes the user's "subjective probability that using a specific application system will increase his or her job performance within an organizational context" ([DBW89], p. 985). PEOU on the other hand is about defined as "the degree to which the user expects the target system to be free of efforts" ([DBW89], p. 985). The TAM suggests that PEOU effects the PU.

The TAM is one of the most used models in information systems [KH06]. Since its emergence it has been subject to a wide variety of research studies that show mixed results. In order to harmonize the findings, several meta-analyses about the TAM were conducted. Four exemplary papers are described in the following.

Legris et al. [LIC03] analyzed the empirical research using TAM in 22 articles. The analysis proves that the TAM is a useful theoretical tool for explaining user's behavior [LIC03]. The results show some limitations as well: A lot of studies involve students; therefore, the generalizability of the results is questionable. In addition, it shows that often business process applications are not considered, only office automation software or systems development applications are analyzed. Finally, in many cases, the TAM measures the self-reported use of the system which leads to the issue of subjectivity of results.

Ma and Liu stated that findings about the TAM are mixed in terms of statistical significance, direction, and magnitude [ML04]. Therefore they carried out a meta-analysis comprising 26 selected empirical studies with the goal of synthesizing the empirical evidence. The results show strong correlations between PU and acceptance as well as between usefulness and PEOU. In contrast to that, the relationship between PEOU and acceptance was found to be weak [ML04].

In 2006 King and He conducted a statistical meta-analysis using 88 papers focusing on the TAM [KH06]. The authors found out that TAM is a powerful and robust tool for predicting users adoption behavior and state that PU, PEOU and behavior intention "are highly reliable and may be used in a variety of contexts" ([KH06], p. 751).

In a 145 papers spanning narrative literature review, Yousafzai et al. analyzed the previous research on the TAM and compared the existing results in order to provide a unified view in the TAM [YFP07]. With their article, the authors illustrate gaps for further research and provided guidelines for the implementation of an appropriate management. The results confirm that the TAM is a robust, parsimonious, and powerful model for predicting users' acceptance of technology. Yousafzai attribute the widespread application of the TAM by its specific design for explaining and predicting of a diverse user population's acceptance of a wide range of systems, its strong theoretical base and its strong empirical support [YFP07].

The four mentioned literature reviews help to integrate existing articles on the TAM and their prior unclear and confusing findings [YFP07] into a consistent picture. However, it is still unclear what factors influence the PU and PEOU. Davis called these the external variables and a plethora of research focused on finding concepts that fit into that term. The TRA as well as the TAM suggest that these external variables influence the users attitude and behavior indirectly [LIC03]. Examples for these factors may be in personal or individual traits, organizational factors, or technological aspects [RSE16].

One limitation of the TAM refers to the fact that although giving insight into user's acceptance and use of technology, it does not explain how these perceptions can be exactly influenced [Ma91]. Previous research reported more than 70 relevant external variables [YFP07]. I remains unclear, what external variables exist, how they can be influenced and what the most important variables are. These questions are considered especially relevant for practitioners [CG95].

The article at hand takes on this issue and focusses on the following research questions:

- *What external factors influence the adoption of information systems in businesses?*
- *What external variables are considered most relevant for technology adoption?*

The remainder of this paper is organized as follows: The next section describes an extensive literature review process that was conducted in order to identify relevant research papers. Next we describe the external variables that are reported in the TAM literature. Finally, we discuss the findings and suggest implications for researchers and practitioners.

2   TAM literature review

In order to provide a substantiated answer to the research questions, a comprehensive literature review was conducted. An initial search with the exact key phrase "Technology Acceptance Model" on google scholar revealed 21700 results. This indicates the wide spread and application of the model. In the following research process scientific papers were considered that were either published in conference proceedings or scientific journals.

Since the google search indicated a plethora of relevant papers and because of the long timespan since the introduction of the TAM, we expected a lot of research papers to be relevant. To the end of identifying these papers, different sources of scientific contributions were considered [vo09]. We chose the approach of incorporating different databases in order to ensure that as many relevant articles as possible were included in the analysis without missing important papers due to licensing issues. Following the recommendation by vom Brocke et al., databases were considered that provided access to leading information systems journals to ensure that all the top-tier sources were included in the review [vo09]. We used four databases for the literature identification: ACM, EBSCO Business Source Complete, Emerald, and IEEE. Within these databases publications using the phrase "Technology Acceptance Model" in the keywords were incorporated in the literature analysis. The time frame of the publications considered lies between 1995 and 2015. Table 1 gives an overview over the number of papers considered: In total 763 papers were comprised in the literature analysis.

ACM	EBSCO	Emerald	IEEE	Google Scholar
58	471	59	175	21700

Tab. 1: Quantitative Results of the Literature Analysis

3   External variables

763 identified papers build the base of the literature review. In order to systematically gather the factors that were counted to the external variables in the TAM literature, we followed a four step process:

Firstly, to carve out the external variables in the literature, all the paper were scanned for their mentioning. We collected these variables as well as their definitions if available. In a second step we checked for duplicates and grouped identical variables with each other. In total 552 unique external variables were found in the TAM literature. The third step consisted of a counting of the frequency of appearance. This frequency was used as an indicator of the importance of the single external variables. Then, following Yousafzai et al. [YFP07], we grouped the unique external variables into four categories: Organizational Characteristics, System Characteristics, User Personal Characteristics, and Other Variables. These categories are described in the following.

3.1   Organizational Characteristics

The first category deals with characteristics that refer to the organizations. Using the frequency of the mentioning we created a ranking to identify the most important characteristics: On rank 1 the variable "Service Quality" can be found (10 mentions). It deals with the "availability of communication mechanisms for accepting consumer complaints and timely resolution of them with responsiveness, assurance, and follow up services" [ARH07]. Rank 2 is occupied by "Facilitating Conditions" (5). Further important variables are: "Internal Support (Computing Support)" (4), "Technical Support" (4) and "Trialability" (3). Table 2 shows the Top 5 Organizational Characteristics including their exemplary definitions.

Rank	Frequency	Variable	Exemplary definition
1	10	Service Quality	Refers to availability of communication mechanisms for accepting consumer complaints and timely resolution of them with responsiveness, assurance, and follow up services [ARH07].
2	5	Facilitating Conditions	The degree to which an individual believes that a satisfactory level of an organizational and technical infrastructure exist to support use of the system [EO10].
3	4	Internal Support (Computing Support)	The technical support by individuals (or groups) with computer knowledge who were internal to the (…) firm [IZC97].
4	4	Technical Support	The degree to which a user perceives the provision of (…) assistance in technical support services [Ch14].
5	3	Trialability	The degree to which it can be experimented with on a limited basis [CH09].

Tab. 2: Top 5 Organizational Characteristics

3.2   System Characteristics

This category contains the variables in respect to the information technology. The most important variable is "Result Demonstrability" (16), which focusses on the effects of system usage on the achieving results [HK12]. It is followed by "Information, Output, and System Quality" that occur in 13 papers each. These three variables indicate that quality is important for technology acceptance – may it refer to the produced information in the system, the support of the individuals' tasks or to the performance of the information system in general. On rank 5 is the "Compatibility" (12) with existing values, experience, and needs [ZGC08]. The five most important System Characteristics are shown in Table 3.

Rank	Frequency	Variable	Exemplary definition
1	16	Result Demonstrability	The tangibility of the results when using the new system [HK12].
2	13	Information Quality	The quality of the information that the system produces [Fe14].
3	13	Output quality	The degree to which an individual believes that the system supports his/her tasks well [LPO15].
4	13	System Quality	Performance of Information Systems in terms of reliability, convenience, ease of use, functionality and other system metrics [SA14].
5	12	Compatibility	The degree to which an innovation is perceived as consistent with the exciting values, past experience, and needs of potential adopters [ZGC08].

Tab. 3: Top 5 System Characteristics

3.3   User Personal Characteristics

This category of external variables deals with characteristics in respect to the user. At first place lies the variable "Computer Self-Efficacy" (29). It describes the individual's self confidence in using the system properly. But also the enjoyment users perceive in the usage of the system plays a decisive role in the acceptance of the technology: "Perceived Enjoyment" (26). Further variables in this category are: "Self Efficacy" (23), "Trust" (15) and "Personal Innovativeness" (14). The five most common Personal Characteristics are described in Table 4.

Rank	Frequency	Variable	Exemplary definition
1	29	Computer Self-Efficacy	An individual's self-confidence in his or her ability to perform operations across multiple computer operation domains [NBK13].
2	26	Perceived Enjoyment	The extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use [LPO15].
3	23	Self-Efficacy	The judgment of a person about unique abilities to execute a chain of actions whatever skills needed to process [TG14].
4	15	Trust	The willingness of a party to be vulnerable to the actions of another party based on the expectation that the latter one will perform particular actions, which are important to the former one [Hu08].
5	14	Personal Innovativeness	The degree to which an individual or other unit of adoption is relatively earlier in adopting an innovation than other members of a social system [Hu14].

Tab. 4: Top 5 User Personal Characteristics

3.4   Other Variables

"Subjective Norm" is the external variable that appeared most often in the analyzed literature (41). This indicates that the opinions of important persons are considered very important in the individuals' decision to adopt the new technology. On rank 2 the question of the "Image" (status in the social system) can be found (19). In this category the variables "Job Relevance" (13), "Social Influence" (13) and "Task-Technology-Fit" (9) are to mention as well. Please see Table 5 for the most important Other Variables in respect to external variables in the TAM.

Rank	Frequency	Variable	Exemplary definition
1	41	Subjective Norm	The person's perception that most people who are important to him think that he should or should not perform the behavior in question [Pa12].
2	19	Image	The degree to which an individual perceives that use of an innovation will enhance his or her status in a social system [FJ15].
3	13	Job Relevance	The individual's perception on the degree to which the target system is relevant to his/her job [LPO15].
4	13	Social Influence	The degree to which an individual believes that people who are important think that she/he should perform the behavior [EO10].
5	9	Task Technology Fit	The degree to which information technology meets a user's task needs [Le12].

Tab. 5: Top 5 Other Variables

4   Conclusion

This paper provides an extensive analysis of literature on the TAM in the years 1995 to 2015. It focusses on the identification of external variables that are mentioned in respect to the TAM. During the analysis 763 papers were found to be relevant to this topic and the analysis indicated 552 unique external variables. In order to categorize this magnitude of variables we followed Yousafzai et al. [YFP07] and group them into four categories: Organizational Characteristics, System Characteristics, User Personal Characteristics, and Other Variables.

An analysis of the frequency of the mentions of single external variables allowed the building of a ranking in each of the four categories: These rankings can be used as an indicator of the importance of singe variables since this frequency describes research interest. The most important variable in the category "Organizational Characteristics" is "Service Quality". In "System Characteristics" "Result Demonstrability" is described most often and within "User Personal Characteristics", "Computer Self-Efficacy" plays the most important role. The top variable in "Other Variables", "Subjective Norm", is also the variable with the most mentions of all external variables in papers on the TAM. This suggests that the "Subjective Norm" is the most important determinant influencing PU and PEOU.

As all research, this paper is of limited scope. In order to depict the status quo of research, papers from 1995 to 2015 were considered. Further research might broaden the focus to other years of TAM research. Additionally, future research could focus on the identification of further external variables that have not been subject to research. The paper at hand also provides a promising starting point for the creation of an integrated model containing all the external variables identified. This could help to synthesize the existing research on the TAM and provide a base academics can build their work on. Additionally, empirical research seems desirable in order to identify the variable that have the biggest impact on PU and PEOU.

This research has also implications for practice: The literature review at hand sheds light on the question what factors are most important in individuals' acceptance of technology. Managers can use the rankings provided in this paper to get an idea of what external factors are relevant and deduct actions that facilitate the described variables.

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