Effect of Moderators on Determinants: A Case Study of Technology Acceptance Models

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Abstract – From a few decades, studies has been conducted on various technology acceptance models to predict user acceptance of information technologies. These days various types of tools and information technologies are used in organizations. The success of organization depends on use of these technologies. For the organizations to meet their goals, it becomes important that the technologies are adopted in the organizations and those technologies are accepted by the users. But sometimes these technologies are rejected due to the lack of understanding of behavioral intentions of the users. TAM has remained important model in the previous studies and has provided good results also. But now a new model UTAUT has evolved in this study. This research paper conducts an experimental study on both the models to check the effect of moderators on determinants for understanding behavioral intention of the users. Questionnaire related to the models were distributed to students of colleges, who were using computer software like Tally, Photoshop, Ms-excel. Analysis was done by cronbach’s alpha analysis, correlation analysis and regression analysis. The research concludes perceived usefulness and performance expectancy are more important determinants than the others in understanding behavioral intention of users and suitable moderators provide better understanding of user acceptance of information technology.

Keywords: Human computer interface, Technology acceptance model, Unified theory of acceptance and use of technology, Information technology.

1. INTRODUCTION

In 1970’s increasing failures of systems decreased the adoption of system in the organizations. Information technology offers the potential for substantially white collar performance [1]. But performances of information systems depend on user acceptance or rejection. Davis proposed that system use is a response that can be explained or predicted by user motivation, which in turn depends on the features and capabilities of the system [2]. Many computer based tools or software are used by users and organizations to support planning, decision making and other tasks that lead to productivity of organizations. However, end users are often unwilling to use available computer system that, if used, would generate significant performance gains [3].

Organizations are interested in knowing the return on these investments. The impacts of IT are often indirect and influenced by human, organizational and environmental factors. Over the last two decades, a significant body of research has focused on identifying various factors that influence user acceptance behavior advancing several theoretical models [4].

Many researchers have studied the impact of user’s belief and attitude to predict system usage. A prospective user’s overall attitude towards using a given system is hypothesized to be a major determinant of whether or not he or she actually uses it [5]. These internal beliefs and attitudes are in turn influenced by some external variable that include system features and users behavior. The research on user acceptance is related to Human-Computer Interaction (HCI) and man-machine studies. The models trace the effects of system design
characteristics through studying different variables and factors which helps in knowing people’s intentions to use the system.

Venkatesh in 2000 added that the Technology Acceptance Model (TAM) is a good model but that it does not help understand and explain the acceptance of technology in a way that promotes the development of strategy having a real impact on usability and acceptance of technology [6].

Venkatesh theoretically and empirically compared TAM to seven other intention models of user acceptance that are in literature and developed a model that unifies the key intention determinants across the eight models as well as moderating variables- Unified Theory of Acceptance and Use of Technology (UTAUT) model. This research focuses on the effects of moderators on determinants in both models and how it helps in understanding behavioral intention of users.

2. LITERATURE REVIEW

2.1 TECHNOLOGY ACCEPTANCE MODEL (TAM)

TAM was introduced by Davis which is an adaptation of TRA specifically tailored for modeling user acceptance of information systems.

The goal of TAM is to provide an explanation of the determinants of computer acceptance that is capable of explaining user behavior across a broad range of end-user computing technologies and user populations. As shown in Figure 1, Perceived usefulness has a direct effect on behavioral intention to use [7]. Perceived ease of use directly effects the perceived usefulness and behavioral intention to use.

TAM is helpful in predicting and explaining, so that researchers and practitioners can identify why a particular system may be unacceptable and pursue appropriate corrective steps. A key purpose of TAM is to provide a basis for checking the impact of external factors on internal beliefs, attitudes, and intentions. Venkatesh and Davis in 1996 focused on understanding the antecedents of the perceived ease of use.

They concluded that computer self-efficacy acts as a determinant of perceived ease of use both before and after hands-on use and that the objective usability was found to be a determinant of ease of use only after direct experience with a system [8]. TAM was formulated to achieve these goals by identifying a small number of fundamental variables suggested by previous research dealing with the cognitive and affective determinants of computer acceptance.

![Figure 1. Technology Acceptance Model (TAM) [2].](image-url)
TAM comprises of two particular beliefs, perceived usefulness and perceived ease of use that are of primary relevance for computer acceptance behaviors. Perceived usefulness (U) is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational. Perceived ease of use (EOU) refers to the degree to which the prospective user expects the target system to be free of effort. Usability testing also makes use of ease of use and usefulness. User acceptance is often the pivotal factor determining the success or failure of an information system project [5]. Further, such systems are often used in environments that are changing constantly, where new processes and procedures are being introduced to the environment constantly [9]. The overall system should be flexible to allow users to complete tasks in ways that might not have been considered during original design. The system needs to be designed with usefulness at the first usability criteria rather than as one that is assumed to be met when a series of ease of use criteria are met.

The actual use and behavioral intention relationship represented in TAM implies that, all else being equal, people form intentions to perform behaviors toward which they have positive affect.

Usability Engineering measures behavior within a tightly controlled region and establishes only that users can perform to a certain level with the system under test. The performance impacts concerning ease of use are a subset of usefulness. Making a system easier to use, all else held constant, should make the system more useful.

The converse does not hold, however. This concludes that ease of use influences usefulness but not vice versa as is shown TAM model.

2.2 UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY

The UTAUT aims to explain user intentions to use an information system and subsequent usage behavior. The theory holds that four key constructs which are performance expectancy, effort expectancy, social influence, and facilitating conditions and are the direct determinants of usage intention and behavior. Gender, age, experience, and voluntariness mediate the impact of the four key constructs on usage intention and behavior.

These are known as moderators as they can vary the affect of determinants on behavioral intention. The models use used in user acceptance has two limitations: low explanatory power and inconsistencies in influence. Moderators are used to overcome these limitations.

The theory was developed through a review and consolidation of the constructs of eight models that earlier research had employed to explain information systems usage behavior [10]. UTAUT provides great promise to enhance our understanding of user acceptance. However, the initial UTAUT study focused on large organizations [11]. Particularly with website design and mobile devices, Human-Computer Interaction practitioners face the challenges of designing across cultures daily. Although the UTAUT model posits that the Effort Expectancy construct can be significant in determining user acceptance of information technology, concerns for ease of use may become non-significant over extended and sustained usage [12].

Therefore, perceived ease of use can be expected to be more salient only in the early stages of using a new technology and it can have a positive effect on perceived usefulness of the technology.

Technology acceptance has emerged as a strong candidate for cross-cultural validation of HCI tools. Previous research has undertaken some work to cross-culturally validate and culturally extend technology acceptance models, such as the Technology Acceptance Model (TAM).

However, the Unified Theory of Acceptance and Use of Technology, UTAUT, is a more recent instrument, which is a synthesis of eight existing models of technology acceptance including TAM. Many studies have proved the validity of internal beliefs or core determinants of Unified Theory of Acceptance and User of Technology (UTAUT) as shown [15]. The model is shown in Figure 2.
The four key constructs are:

1. Performance expectancy: the degree to which an individual believes that using a particular system would improve his or her job performance;

2. Effort expectancy: the degree of simplicity associated with the use of a particular system;

3. Social influence: the degree to which an individual perceives that others believe he or she should use a particular system;

4. Facilitating conditions: the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of a particular system.

However, by taking moderating factors into account, we are more confident in explaining and describing the meanings of existing models [14].

3. RESEARCH METHODOLOGY

In this case, the research methodology used is field study. The users of technology i.e. computer software were the students of colleges using Tally, Adobe Photoshop and MS-Excel. Two different questionnaires’s, one related to TAM and second related to UTAUT, were prepared for comparison. The questionnaire was distributed among 200 students of different colleges, out of which 70% were males and 30% were females and analyzed with PSPP data analysis tool. 7-point likert scale was used to analyze the responses of users. PSPP is open source software available for analysis of sampled data. It has a graphical user interface and conventional command-line interface. This software provides a basic set of capabilities: frequencies, cross-tabs comparison of means, linear regression, reliability (Cronbach's Alpha), re-ordering data, non-parametric tests, factor analysis, correlations and regressions. A limited range of statistical graphs can be produced, such as histograms, pie-charts and np-charts.
4. ANALYSIS AND RESULTS

Three type of analysis are performed on TAM and UTAUT to see the effect of determinants and moderators on behavioral intention of users:

1. Cronbach’s Alpha analysis – This analysis is used to test the reliability of determinants. A value cronbach’s alpha higher than 0.70 makes the determinant valid and reliable [13]. If the value of reliability is lower than 0.70, then the determinant having low value is discarded. The values generated from the analysis evaluate whether the determinants or constructs used in the model are valid and they can be used for further analysis.

The results for cronbach’s alpha analysis show that reliability for perceived usefulness is 0.83, perceived ease of use is 0.82 and behavioral intention is 0.85, in case of TAM. In case of UTAUT reliability for performance expectancy is 0.86, for effort expectancy is 0.85, for social influence is 0.74, for facilitating conditions is 0.81 and for behavioral intention is 0.85.

<table>
<thead>
<tr>
<th>Model</th>
<th>Determinants</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAM</td>
<td>Perceived Usefulness</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>Perceived Ease of use</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>Behavioral Intention</td>
<td>0.85</td>
</tr>
<tr>
<td>UTAUT</td>
<td>Performance Expectancy</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>Effort Expectancy</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>Social Influence</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>Facilitating Conditions</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>Behavioral Intention</td>
<td>0.85</td>
</tr>
</tbody>
</table>

This means that the questionnaire made for both TAM and UTAUT is reliable, as the cronbach’s alpha more than 0.70 is acceptable. The minimum value was for social influence and highest reliabilities were found for Performance Expectancy and Perceived usefulness. 2. Correlation analysis – This analysis is used to check the dependence of each determinant and moderator on behavioral intention of users.

<table>
<thead>
<tr>
<th>Model</th>
<th>Determinants</th>
<th>Gender</th>
<th>Age</th>
<th>Experience</th>
<th>Voluntariness</th>
<th>BI</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAM</td>
<td>Perceived Usefulness</td>
<td>0.75</td>
<td>0.37</td>
<td>0</td>
<td>0</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>Perceived Ease of use</td>
<td>0.30</td>
<td>0.64</td>
<td>0</td>
<td>0</td>
<td>0.83</td>
</tr>
<tr>
<td>UTAUT</td>
<td>Performance Expectancy</td>
<td>0.76</td>
<td>0.41</td>
<td>0.46</td>
<td>0.32</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>Effort Expectancy</td>
<td>0.40</td>
<td>0.68</td>
<td>0.32</td>
<td>0.39</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>Social Influence</td>
<td>0.38</td>
<td>0.36</td>
<td>0.40</td>
<td>0.65</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>Facilitating Conditions</td>
<td>0.42</td>
<td>0.46</td>
<td>0.66</td>
<td>0.46</td>
<td>0.78</td>
</tr>
</tbody>
</table>
From the correlation analysis of TAM, Perceived usefulness and Perceived ease of use are dependent on Behavioral intention and the external variables gender has correlation with perceived usefulness which is 0.75. Age has a correlation of 0.64 with perceived ease of use. This means that these external variables has an indirect influence on behavioral intention of the user, where as no results were found for experience and voluntariness.

In case of UTAUT model, Performance expectancy, Effort expectancy, Social influence and Facilitating conditions are direct determinant of Behavioral intention. Gender is moderator for Performance expectancy having correlation of 0.76, Age is moderator for effort expectancy having correlation of 0.68, experience is moderator for facilitating conditions having correlation of 0.66 and voluntariness is moderator for social influence having correlation of 0.65.

From above analysis it was found that moderator gender affects perceived usefulness and performance expectancy, age affects perceived ease of use, social influence is affected by voluntariness and facilitating condition is affected by experience.

In case of effort expectancy it is clear that TAM and UTAUT provide good results to check the dependency of determinants and moderators, but the determinants and moderators of UTAUT are sufficient to explain user’s intentions to use the system.

3. Regression analysis – This analysis is to evaluate the effect of determinant on the behavioral intention of users.

<table>
<thead>
<tr>
<th>Model</th>
<th>Determinants</th>
<th>$R^2$ (BI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAM</td>
<td>Perceived Usefulness</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>Perceived Ease of use</td>
<td>0.64</td>
</tr>
<tr>
<td>UTAUT</td>
<td>Performance Expectancy</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Effort Expectancy</td>
<td>0.65</td>
</tr>
<tr>
<td></td>
<td>Social Influence</td>
<td>0.52</td>
</tr>
</tbody>
</table>

The results of regression analysis show that in case of TAM, Perceived usefulness has positive effect on behavioral intention, which is 0.67. In case of UTAUT, performance expectancy has positive effect on behavioral intention, which is 0.72. The effect of facilitating condition is not shown as it is not directly dependent on behavioral intention. So, in case of TAM perceived usefulness is the important construct and in case of UTAUT, performance expectancy is important construct than others.

5. CONCLUSIONs & FUTURE SCOPE

The study concludes that moderators play an important role in predicting user acceptance of information technology. The results show that perceived usefulness and performance expectancy are the important constructs than others to understand behavioral intention. The determinants have direct influence on behavioral intention, but when we include moderators in the models, they also have indirect influence over behavioral intention. This indirect influence gives better understanding of user behavior that whether the technology shall be accepted or rejected. Future studies should focus on...
including more suitable moderators in order to better understand the behavioral intention of users.

REFERENCES


