

VISUAL ANALYSIS OF RESEARCH ON ACCEPTANCE OF INFORMATION TECHNOLOGY

Qian-jin Zong, Qin-jian Yuan, Ling-yu Tong and Hong-zhou Shen

Department of Information Management, Nanjing University, No.22 Hankou Road, Nanjing, China

Keywords: Acceptance of information technology, User acceptance, Research focus, Frontier, Knowledge mapping domains.

Abstract: This paper collected 1696 literatures of acceptance of information technology (IT) as the data sample, which were cited by Web of Science (SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH) from 1985 to 2010. Based on the method of mapping knowledge domains, this article used keyword frequency analysis, burst terms detecting, and co-citation analysis to analyse the research focus, frontier and theoretical foundation of acceptance of IT research, and draw the knowledge mapping of them.

1 INTRODUCTION

Information technology (IT) influences every aspect of our society, and has become an indispensable part of one's life and work. Information Technologies are designed for the purposes of supporting productivity and communication in social settings, their values can be realized only if they are accepted/adopted, used, and used continuously by intended users (Zhang and Sun, 2009). Obviously, users' acceptance of IT is the crucial key to the information systems (IS). Scholars have done lots of research on the acceptance and using of IT in the past many years, and this research area has been a hot topic. Moreover, for improving the working efficiency through IT, managers in the organizations pay more attention to the acceptance of IT in recent years too.

For such a rapidly-developing and important area of research, it is necessary to understand the whole view of the research, such as what are the key topics being heavily focused on? And what are the frontiers of the research? And what are the theoretical foundations it is established on? However, there is still no study making efforts to answer these questions. In order to make up this void, this study, based on knowledge mapping domains, is attempting to give a whole view of acceptance of information technology research.

2 METHODOLOGY AND DATA

2.1 Methodology

"Mapping knowledge domains" describes a newly evolving interdisciplinary area of science aimed at the process of charting, mining, analyzing, sorting, enabling navigation of, and displaying knowledge. This field is aimed at easing information access, making evident the structure of knowledge, and allowing seekers of knowledge to succeed in their endeavours (Shiffrin and Börner, 2004). Except combing with the idea of bibliometrics, social network, etc., mapping knowledge domains uses information visualization which developed rapidly recent years. Mapping knowledge domains can be used to find the foundation of the research by citation analysis and to reveal the research focus ,their relations by keyword analysis, such as frequency, centrality and so on .Moreover , it can display the research frontier by detecting burst terms. Because of the vast increases in computational capacity and processing speed, the tools of mapping knowledge domains can deal with massive information, and various analysis tools are available for free, such as Pajek (Batagelj and Mrvar, 1998), UCINET (Borgatti et al., 1999), Netdraw (Borgatti, 2002), and HistCite (Garfield et al., 2006) etc. In this study, CitespaceII (Chen, 2006) and Bibexcel (Persson et al., 2009) are employed.

2.2 Data

This study collects 1696 documents related to acceptance of IT from SCI-EXPANDED, SSCI, A&HCI, CPCI-S, and CPCI-SSH in ISI Web of Science. (The results were obtained on 25th Jan. 2011.) The date range of these collected documents is from 1985 to 2010. Then we merge these records into one txt file, and use BibExcel to analyse the source publications. The papers are published in 597 publications and table 1 shows the top 10 source publications of these recordings, and they are mainly about the Computer, Information, Behaviour and Management.

Table 1: The top 10 source publications in acceptance of IT.

	Publication title	Freq
1	Information & Management	69
2	Computers in Human Behavior	56
3	MIS Quarterly	52
4	Journal of Computer Information Systems	45
5	Behaviour & Information Technology	33
6	Computers & Education	32
7	European Journal of Information Systems	31
8	International Journal of Human-Computer Studies	27
9	Decision Support Systems	24
10	International Journal of Information Management	22

3 ANALYSIS AND RESULTS

3.1 Research Focus in Acceptance of IT

Keywords can reflect the research results and the understanding of authors; it is the essence of an article. Scholars can find the focus topic in a research area by analysing keywords. We select keyword as the node of network and set $(c, cc, ccv) = (4, 2, 10; 6, 4, 15; 6, 4, 15)$ as the threshold value in Citespace II. Then, a network of keywords in acceptance of IT research is generated as shown in figure 1, with 79 nodes and 222 links totally. Table 2 shows the keywords which freq are over 100.

In the network of keywords, it is clear that two biggest nodes linking to numerous smaller nodes take the centre place. And the two nodes represent the keywords “information-technology” and “user acceptance” whose freq are 827 and 674 respectively. More over, these two keywords have high centralities, with 0.23 for “information-technology” and 0.19 for “user acceptance”. The index “centrality” measures the frequency of a word

jointly appearing with other words. The higher the jointly appearance frequency is, the higher the centrality is.

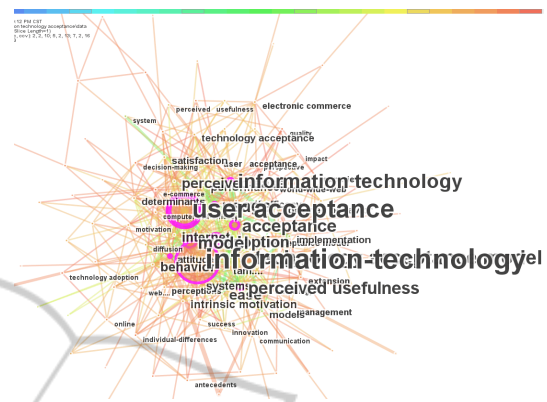


Figure 1: Network of keywords used in acceptance of information technology research.

Table 2: The keywords whose freq exceed 100 used in acceptance of information technology research.

Keywords	Freq	Centrality
information-technology	827	0.19
user acceptance	674	0.23
information technology	436	0.19
Technology acceptance model	421	0.07
Model	330	0.12
acceptance	317	0.12
usage	298	0.16
perceived usefulness	296	0.1
adoption	275	0.23
ease	213	0.06
perceived ease	201	0.04
behavior	186	0.08
internet	164	0.07
systems	155	0.05
intrinsic motivation	137	0.02
performance	137	0.08
self-efficacy	125	0.02
attitudes	120	0.14
trust	118	0.08
models	116	0.08
technology acceptance	115	0.03
implementation	114	0.01
satisfaction	110	0.05
determinants	105	0.02
planned behavior	102	0.01
tam	100	0.04

These two keywords appear most frequently, and are jointly used with other word to specify the research directions of studies. Apart from these, there are still other keywords used frequently in acceptance of information technology research as

shown in Table 2. Among these words, however, some have the similar meanings or fail to make a clear description of the studies. For example, “model” and “models” almost have the same meaning, and it is the same with “user acceptance” and “acceptance” and so on. Furthermore, some keywords are very broad terms, such as “information technology”, “systems”, etc. Considering the above, we extract the following three focused topics from these keywords: “user acceptance/adoption”, “technology acceptance model”, and “planned behavior”.

3.1.1 Online User Acceptance

From the figure 1, the keywords “web”, “internet”, “electronic commerce” are connected with the node “user acceptance”. As the information technology developed rapidly, the research of user acceptance not only in the traditional IT environment such as ERP, etc., but also in the online environment, especially in the online shopping which is one of the most important areas of electronic commerce. A major problem facing online shopping service providers is the heterogeneity of user profile, unlike organizational systems that have a well-defined universe of users and system boundary; these shopping services are designed for public users with very different cognitive and demographic profiles (Chau et al., 2000). Thus, user acceptance of electronic commerce has many problems for us to solve and this area will be still a research focus in the following years.

3.1.2 Research Focus related to User Emotion

Another research focus is the area related to user emotion. It concludes “intrinsic motivation”, “perceived useless”, “performance”, “self-efficiency”, “customer satisfaction”, “behavioural intention”, and “experience”, etc. Based on these topics, some models are proposed by researchers. Taking performance and customer satisfaction for example, the models of this research area are based on the Expectation-Confirmation Theory (ECT), and Expectation-Confirmation Model is a typical representative. ECT assumes that expectations, coupled with perceived performance, lead to post-purchase satisfaction. Satisfaction is believed to influence attitude change and purchase intention. If a product outperforms expectations (positive disconfirmation) post-purchase satisfaction will result. If a product falls short of expectations (negative disconfirmation) the consumer is likely to

be dissatisfied (Oliver, 1980; Spreng et al., 1996). There are four main elements which conclude expectation, performance, disconfirmation and satisfaction in this theory.

3.1.3 Technology Acceptance Model

Technology acceptance model (TAM) which is proposed by Davis and others on the basis of TRA is currently the most widely user acceptance model. TAM includes two major determinants: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). PU is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance”. And PEOU is defined as “the degree to which a person believes that using a particular system would be free from effort” (Davis, 1989). TAM postulates that user behavior is determined by Behavior Intention, and the Behavior Intention is jointly determined by the Attitude Toward Using and Perceived Usefulness. According to TAM, Attitude Toward Using is jointly determined by PU and PEOU. The PU is jointly determined by the PEOU and the External Variables, and PEOU is also determined by external variables. Table 3 and Figure 1 show that TAM is a very hot topic in acceptance of IT. And many scholars found a number of other influential factors in technology acceptance research and optimized the TAM.

3.1.4 Planned Behaviour

The Theory of Planned Behavior (TPB) is the extension of Theory of Reasoned Action and adds the concept of perceived behavioral control. After being proposed by Ajzen in 1985, TPB (Ajzen, 1985) has been widely used in the research of user acceptance of information technology, and most of researches support it. Moreover, some scholars compared the TPB to TRA in the online marketing, and found that TPB is more suitable than TRA. One research tests the ability of two consumer theories—the Theory of Reasoned Action and the Theory of Planned Behaviour—in predicting consumer online grocery buying intention, and the results suggest that the theory of planned behaviour (with the inclusion of a path from subjective norm to attitude) provides the best fit to the data and explains the highest proportion of variation in online grocery buying intention (Hansen et al., 2004).

3.2 Frontiers in Acceptance of IT

Citespace provides a technology and algorithm to

find the research frontier by using burst terms detecting. Burst term is the word whose frequency changes rapidly in a time period, not just its frequency is high or low. By using this function, we find top 15 burst terms: originality value, perceived risk, subjective norms, mobile commerce, computer anxiety, performance expectancy, user adoption, effort expectancy, behavioural intention, computer based, relative advantage, acceptance research, web site, electronic commerce, and consumer behavior as shown in figure 2.



Figure 2: Network of frontiers in acceptance of information technology research.

In the network of frontiers, the node “consumer behavior” takes the centre place with numerous links to other smaller nodes. With the frontiers above and Figure2, we can see that online user research, especially the research of user in electronic commerce has attracted the scholars. Electronic commerce has developed rapidly all over the world in recent years. As the core of E-commerce, users will have a significant impact on the continued development of E-commerce. For this reason, the study of user acceptance in E-commerce will be a trend in acceptance of IT in the following years.

Applications of web2.0, especially the social networking services (SNS) provide a different way for people to communicate with each others, and these services have become very popular in recent years. From Figure 2, we can see that web2.0 is also a frontier in acceptance in IT, such as social network, online social, social support, etc.

In addition, as the mobile technology developed, applications & services based on mobile Internet

have been used widely. The number of users in mobile Internet has increased rapidly. Thus, the research of user acceptance in the industries related to mobile has gradually aroused the concern of researchers. And this research area is a research frontier. From the Figure2, mobile commerce, mobile shopping, mobile TV, mobile data service, (mobile) phone users, new mobile service, 3G services, etc. deserves some attention.

3.3 Theoretical Foundations of Acceptance of IT Research

References are the knowledge source of the research work, and using citation analysis can find the theoretical foundations. Citation analysis is one of the most widely used methods of bibliometrics. In this study, we use the function named “cited reference analysis” of Citespace and set cited reference as the node of network. By running the tool, a network of cited references is generated as shown in figure 3, with 147 nodes and 366 links totally.

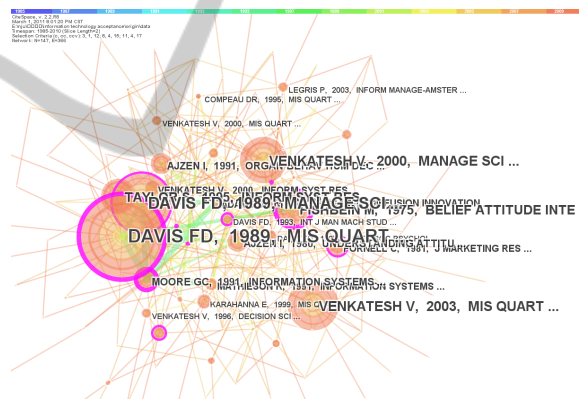


Figure 3: Network of cited references in acceptance of IT research.

In the Figure3, one node represents a cited reference, and its size indicates the citation frequency of the reference. The node and font is bigger, the citation frequency (centrality) is higher and this means that the literature is important. From Figure 3, we can clearly see 6 biggest nodes and other bigger nodes in the centre of the network, and other smaller ones surround them. These big nodes linked with each other closely. In other words, these big nodes, or rather these classical literatures establish most of the foundation of research. The top 6 most frequently cited references in Table 3 whose cited frequency are all over 390. These references are the key literatures in acceptance of IT research.

In other words, these key literatures construct the theoretical foundations of acceptance of IT research.

Table 3: The top 6 cited references in acceptance of IT research.

Freq	First Author	Title	Year
1072	DAVIS FD	Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology	1989
798	DAVIS FD	User acceptance of computer technology: a comparison of two theoretical models	1989
635	VENKATESH V	User Acceptance of Information Technology: Toward a Unified View	2003
576	VENKATESH V	A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies	2000
528	TAYLORS	Understanding information technology usage: A test of competing models. Information Systems Research	1995
489	Fishbein M	Belief, attitude, intention, and behavior : An introduction to theory and research	1975

The biggest node in Figure3 is “Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology” written by Davis in 1989. This study considers two specific variables, perceived usefulness and perceived ease of use, which are hypothesized to be fundamental determinants of user acceptance. And in his another article (Davis, et al., 1989) which is the second biggest node in Figure3 , addresses the ability to predict peoples' computer acceptance from a measure of their intentions, and the ability to explain their intentions in terms of their attitudes, subjective norms, perceived usefulness, perceived ease of use, and related variables. These two literatures are the basis of the research in technology acceptance model (TAM). Based on TAM, later scholars extended the theory and developed some new model.

The literature in third and fourth place is written by Venkatesh. These two literatures are the knowledge source of TAM2 and UTAUT. Researchers found that both social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and

perceived ease of use) significantly influenced user acceptance, and a new model named TAM2 was proposed in 2000. (Venkatesh and Davis, 2000). In 2003, one research gives a review and an empirical study on the eight existing models of user acceptance, then a unified model called the Unified Theory of Acceptance and Use of Technology (UTAUT) was proposed. Researchers theorize that four constructs plays a significant role as direct determinants of user acceptance and usage behavior: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al.2003).

The fifth biggest node is the article co-written by Taylor and Todd in 1995. The TAM and two variations of the Theory of Planned Behavior were compared to assess which model best helps to understand usage of information technology in this study, and the results revealed that all three models performed well in terms of fit and were roughly equivalent in terms of their ability to explain behaviour (Taylor and Todd, 1995).

The literature written by Fishbein and Ajzen is the sixth biggest node in the Figure3.They developed the theory of reasoned action (TRA) in this literature in 1975. According to this theory, attitudes toward a behavior and subjective norms are the significant predictors of behavioral intention. And the subjective norm is the person's perception that most people who are important to him think he should or should not perform the behavior in question (Fishbein and Ajzen, 1975).

4 CONCLUSIONS

Acceptance of information technology is not a new research area, but this research area is so important that more and more people pay high attention to it after its appearance. Based on the above analysis, we draw such conclusions as followed:

- 1) User acceptance, user adoption, intrinsic motivation, self-efficacy, satisfaction, planned behaviour, technology acceptance model, etc. are the focus research topic in acceptance of IT.
- 2) As the technology developed, the research frontiers appeared some new developing trends. User acceptance in electronic commerce, mobile services, and social network (web2.0), etc. are the research frontiers in acceptance of IT.
- 3) The literatures about TAM, TAM2, TPB, TRA, etc. are the knowledge resource, or rather, the theoretical foundations of acceptance of IT. And the

authors Davis F. D., Venkatesh V., Taylor S., Fishbein M. and Ajzen I., etc are the main contributors to this research field.

ACKNOWLEDGEMENTS

This research is included in the programme “Research on the Marketing Model of Digital Publication” supported by National Funds of Social Science. And the number of the programme is 07BTQ003.

REFERENCES

- Zhang, P., Sun, H. (2009). The complexity of different types of attitudes in initial and continued ICT use. *Journal of the American Society for Information Science and Technology*, 60, 2048–2063.
- Shiffirin, R. M., & Börner, K. (Eds.). (2004). Mapping knowledge domains. *Proceedings of the National Academy of Sciences, USA*, 101(Suppl. 1), 5183–5310.
- Batagelj, V., Mrvar, A. (1998). Pajek – A Program for large network analysis. *Connections*, 21 (2), 47–57.
- Persson, O., Danell, R. & Schneider, J. W. (2009). How to use Bibexcel for various types of bibliometric analysis. *Celebrating Scholarly Communication Studies: A Festschrift for Olle Persson at his 60th Birthday*. Ed.
- Fredrik Åström. Special volume of the e-zine of the ISSI, 05-S, 5-89.
- Borgatti, S. P., Everett, M. G., & Freeman, L. C. (1999). UCINET 5.0 Version 1.00. *Natick: Analytic Technologies*.
- Borgatti, S. P. (2002). NetDraw: Graph Visualization Software. *Harvard: Analytic Technologies*.
- Garfield, E., Paris, S. & Stock, W. G., (2006). HistCited™: A Software Tool for Informatic Analysis of Citation Linkage. *Information Wissenschaft und Praxis*, 57, 391–400.
- Chen C. (2006) .CiteSpace II: detecting and visualizing emerging trends and transient patterns in scientific literature. *Journal of the American Society for Information Science and Technology*, 3,359–377.
- Chau, P. Y. K., Au, G. & Tam, K. Y. (2000) .Impact of information presentation modes on online shopping: an empirical evaluation of a broadband interactive shopping service. *Journal of Organisational Computing and Electronic Commerce*, 10(1), 1–22.
- Oliver R. L. (1980). A Cognitive Model of the Antecedents and Consequences of Satisfaction Decisions. *Journal of Marketing Research*, 17(3), 460–469.
- Sprengr R. A, MacKenzie, S. B. & Olshavsky R. W. (1996). A reexamination of the determinants of consumer satisfaction. *Journal of Marketing*, 60(3), 15–32.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340.
- Davis, F. D, Bagozzi, R. P. & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science* 35(8), 982–1003.
- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckman (Eds.), *Action-control: From cognition to behavior. Heidelberg, Germany: Springer*.
- Hansen, T., Jensen, J. M., & Solgaard, H. S. (2004). Predicting online grocery buying intention: A comparison of the theory of reasoned action and the theory of planned behavior. *International Journal of Information Management*, 24(6), 539–550.
- Venkatesh, V., Davis, F. D. (2000). A theoretical extension of the technology acceptance model: four longitudinal field studies. *Management Science*, 46(2), 186–204.
- Taylor, S., Todd, P. (1995). Understanding information technology usage: a test of competing models. *Information Systems Research*, 6(2), 144–176.
- Fishbein, M., Ajzen, I. (1975). *Belief, attitude, intention, and behavior: an introduction to theory and research*. Reading, Mass: Addison-Wesley Pub.