

## UNDERSTANDING ACCEPTANCE OF HIGH TECHNOLOGY PRODUCTS: 50 YEARS OF RESEARCH

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This survey of research on acceptance of technology over the past fifty years was conducted to identify and clarify those variables that influence technology acceptance, particularly those that are related to aspects of the technology itself. We surveyed the literature across many domains, selected articles related to this research area, and coded these articles based on the studied variables and products. The results of this survey are an organizational schema for all of the variables as well as specific guidance on the generalized effects of relevant variables such as perceived usefulness, perceived compatibility, and perceived privacy. For each critical variable, we discuss the implications to guide designers of high-technology products.

Designing products that people will want to use is a design ideal (Norman, 2002). However, sometimes even carefully designed products are not accepted, or are even rejected outright leaving designers and company executives to ask why their careful investments did not help them create the right product. The answer to the question of why a product is accepted or rejected is a complex one, and currently there is no integrated theory to provide a guide to even begin to answer it. Nevertheless, over the past 50 years researchers from different disciplines have examined product acceptance and have made potentially useful suggestions for creating products that people want.

Researchers interested in this question began investigating technology acceptance over 50 years ago. However, beginning in the 1980s (perhaps not so coincidentally at the same time microcomputers were first becoming widespread) the number of research works published about the acceptance of technology increased dramatically (see Figure 1). Unfortunately this increase was not spurred by an overarching theory that might serve to guide the questions or hypotheses posed in the studies. Instead, researchers from many different disciplines attempted to investigate variables (often in isolation) that might relate to technology acceptance.

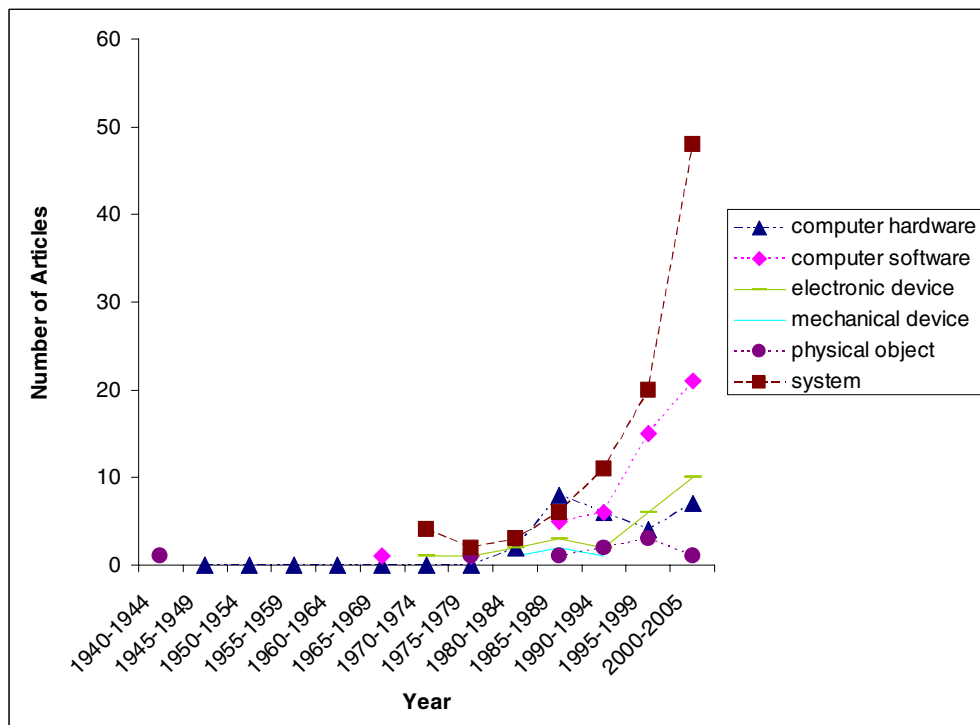


Figure 1. Trends in research on technology acceptance over time.

The purpose of this paper is to summarize the research conducted over the last 50 years related to the acceptance of high technology products. High technology products are defined as “scientific technology involving the production or use of advanced or sophisticated devices especially in the fields of electronics and computers” (Merriam-Webster, 2003). The goal of our research is to provide insights into the variables that influence technology acceptance. Designers can then use this knowledge to design products that will be accepted by users. Our review will also provide researchers with an organizational scheme to help systematize current literature and direct future research.

**OVERVIEW OF RESEARCH DOMAIN**

We conducted a broad review of the literature related to technology acceptance and applied an organizational scheme to simplify and clarify the findings. The preliminary broad search of the literature revealed that the primary domains that were specifically relevant to the question of technology acceptance were human factors, human computer interaction (HCI), information technology, marketing, and management.

**METHOD**

**Literature Search**

We used two methods to locate studies: a keyword search method and an expert opinion method. To begin the keyword search method we conducted a broad review of the literature using the following databases: PsycARTICLES, Psychology & Behavioral Sciences Collection, Social Sciences Citation Index, and PsycINFO using the keyword combinations found in Table 1. Based on this preliminary review we selected the most relevant and well respected journals for the remainder of our review using the keyword search

method. The journals are listed in Table 2. Each of these journals was searched using a set of 21 keywords (listed in Table 1).

For the expert opinion method we asked four senior researchers familiar with human technology interaction to provide references for relevant works that may not have surfaced in the keyword search. We were more inclusive about the types and sources of works in this latter search, allowing works from sources beyond those listed in Table 2.

**Criteria for Inclusion**

Works (including articles, books, chapters, and proceedings papers) were initially screened. For a work to be included, it must have examined some form of technology. The technology discussed could either be a specific technology or technology in general. Second, the study had to have addressed adoption, acceptance, rejection or a similar idea (we found many different terms that connoted acceptance) of technology.

**Coding and Summarizing**

All included works were first summarized then coded using a coding scheme developed specifically for this project. Variables discussed in each of the works were coded into either person characteristics (e.g., age, technology experience, prior experience) or technology characteristics (e.g., perceived usefulness, perceived usability, perceived fun and enjoyment). Although understanding the relationship between person characteristics and technology is important to fully understand technology acceptance, person characteristics cannot be changed through design and are therefore not discussed in this paper. For more information on how individual and organizational user characteristics relate to technology acceptance please see Park, O’Brien, Caine, Rogers, Fisk, Van Ittersum, Capar, & Parsons (2006).

*Table 1. Keywords for Database Search*

Keywords	
• Acceptance	• Rejection of Technology
• Acceptance of Technology	• Risk of Technology
• Adoption	• Technology
• Adoption of Technology	• Technology Acceptance
• Bass Model	• Technology Acceptance Model (TAM)
• Consumer Acceptance	• Technology Adoption
• Customer Acceptance	• Technology Hazard
• Hazard of Technology	• Technology Rejection
• Innovation	• Technology Risk
• Product Acceptance	• User Acceptance
• Rejection	

Table 2. Journals Searched

Discipline	Journal Name
Economics	-American Economic Review -Journal of Technology Transfer -Quarterly Journal of Economics -R&D Management -RAND Journal of Economics -Research Policy
General Psychology	-International Journal of Technology and Aging -Journal of Applied Psychology -Journal of Consumer Psychology -Journal of Experimental Psychology: Applied -Journal of Experimental Psychology: General -Journal of Experimental Social Psychology -Journals of Gerontology -Psychology & Aging -Psychological Reports -Social Science Computer Review
Human Factors/Ergonomics/HCI	-Behaviour & Information Technology -Computers in Human Behavior -Human-Computer Interaction -Human Factors -IEEE Transactions on Engineering Management -International Journal of Human-Computer Interaction -International Journal of Human-Computer Studies
Management	-Academy of Management Journal -Administrative Science Quarterly -Journal of Applied Psychology -Journal of Management -Management Science -Organizational Science -Personnel Psychology -Strategic Management Journal
Marketing	-Journal of Consumer Psychology -Journal of Consumer Research -Journal of Marketing -Journal of Marketing Research -Journal of Product Innovation Management -Journal of the Academy of Marketing Science -Marketing Science
Information Technology	-Information Systems Research -INFORMS Journal on Computing -Journal of Management Information Systems -MIS Quarterly

**RESULTS**

Our literature search revealed 290 works that were relevant to the acceptance of technology. From those works we identified a number of technology characteristics that have been studied. One major finding from the literature was that technology variables that are important for acceptance are usually measured in terms of how they are perceived by a potential user, rather than how they are perceived by a designer or manager, or by

some objective measure. This underscores the importance of getting user input throughout the design process.

**DESIGN IMPLICATIONS**

Our review identified many variables potentially relevant to understanding the acceptance of technology. These results suggest that designers should consider the variables listed in the heuristic tool provided during the design process to increase acceptance while designing high technology products.

### Heuristic Tool

- Perceived usefulness (Davis, 1986)
  - Do users perceive a need for this product? Do they feel that this product will solve a problem they are facing, save them time, or help them do something they would otherwise be unable to do? Products should be designed with the needs of the users in mind, from the beginning.
- Perceived ease of use (Davis, 1986)
  - Do potential users believe that the device will be easy to use? Are there any design changes that could make the product more easy to use? The product should be tested with potential users to validate that it is perceived as easy to use.
- Perceived compatibility (Moore & Benbasat, 1991)
  - Is the product consistent with what users have experienced in the past? If not, what is the reason for the decisions that do not fit with users expectations? If there is not a good reason for the change (a good reason might be that the product is actually easier to use that way), examine modifications that will adjust the design to meet users' expectations.
- Perceived complexity (Rogers, 2003)
  - Do potential users perceive the product as complicated or difficult to understand? In most cases, design should attempt to minimize the complexity that users perceive in a product. Even in products that are extremely complex, such as computers, users want to interact with a simple interface and might be wary of the actual complexity of the overall system. On the other hand, the perception of complexity in a product may be desirable in some cases. For instance, a consumer may associate a complex product with newness or value. The trade-off between the desirable trait of simplicity and the association of complexity with newness must be weighed.
- Perceived fun and enjoyment (Brosnan, 1999)
  - Do potential users believe that using the product will be pleasurable and exciting to use? Beyond being useful or easy to use (which may mean a product is not a displeasure to use) a product should also be designed to bring satisfaction and joy to the user.
- Perceived image (Moore & Benbasat, 1991)
  - Do potential users believe that adopting or using the product will give them increased status in their community? If not, are there restrictions (such as price) that justify or mitigate the perceived image?
- Perceived newness (Gruen, 1960)
  - Do potential users believe that the product is modern and fresh? If potential users believe that a product is out of date or not the latest edition they may be less inclined to accept it
- Perceived privacy (Luarn & Lin, 2005)
  - Do potential users believe that using the device will harm their ability to keep information private or do they believe that it will help them keep information private? If they believe that using the device will harm their ability to keep information private, is there a concrete and visible benefit to mitigate giving up this information? For instance does a service gather information on the users' habits to make the system easier for the user to use or does it gather the information for other purposes that do not benefit the user?
- Perceived relative advantage (Dillon & Morris, 1999)
  - Do potential users believe that the product is a significant improvement over other similar products that they may already own, or could purchase? User studies should be conducted throughout the product life cycle to determine how a new version of a design could be improved compared to an existing one.
- Perceived risk (Featherman & Pavlou, 2003)
  - Do potential users believe that the product could cause unintentional harm to a person or property? If so, what type of harm may occur? Can the product be designed to accomplish the same goals without being dangerous to use? Potential users may be unwilling to accept a product if they perceive a major risk. Every effort should be made during the product life cycle to ensure that the product is safe to use.

### CONCLUSION

When designing a high technology product, designers must consider a number of factors that influence acceptance or rejection of that product. Looking to the literature for guidance with this task revealed the need for more research in several areas including theoretical integration and the need to understand acceptance issues in a broader context. In addition, there is also a need to identify which variables are most predictive of acceptance. Nevertheless, the literature provides some guidance about the factors that designers should consider to increase acceptance. We have provided a heuristic tool for designers to use in the form of questions that should be asked early and throughout the design process. The goal is to illuminate those variables relevant to technology acceptance that could be modified during the design process to enhance user acceptance of the final design.

### REFERENCES

- Brosnan, M. J. (1999). Modeling technophobia: A case for word processing. *Computers in Human Behavior*, 15, 105-121.
- Davis Jr., F. D. (1986). *A technology acceptance model for empirically testing new end-user information systems: theory and results*. Doctoral dissertation, Sloan School of Management, Massachusetts Institute of Technology.
- Dillon, A., & Morris, M. (1999). Power, perception and performance: From usability engineering to technology acceptance with the P3 model of user response. *43rd Annual Conference of the Human Factors and Ergonomics Society*, Houston, TX.
- Featherman, M. S., & Pavlou, P. A. (2003). Predicting e-services adoption: A perceived risk facets perspective. *International Journal of Human-Computer Studies*, 59, 451-474.
- Gruen, W. (1960). Preference for new products and its relationship to different measures of conformity. *Journal of Applied Psychology*, 44, 361-364.
- Luarn, P., & Lin, H.-H. (2005). Toward an understanding of the behavioral intention to use mobile banking. *Computers in Human Behavior*, 21, 873-891.
- Merriam-Webster's Collegiate Dictionary (11<sup>th</sup> ed.) (2003). Springfield, MA: Merriam-Webster.
- Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2, 192.
- Norman, D.A. (2002). *The Design of Everyday Things*. New York: Basic Books.
- Park, S., O'Brien, M.A., Caine, K.E., Rogers, W.A., Fisk, A.D., Van Ittersum, K., Capar, M., & Parsons, L.J. (2006). Acceptance of Computer Technology: Understanding the User and the Organizational Characteristics. *Proceedings of the Human Factors and Ergonomics Society 50<sup>th</sup> Annual Meeting*. Santa Monica, CA: Human Factors and Ergonomics Society.
- Rogers, E. M. (2003). *Diffusion of Innovations* (5<sup>th</sup> ed.). New York: Free Press.

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