HCI: User acceptance

User acceptance of information technology

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1. Introduction

Despite significant investments in information technology in developed nations over recent decades, concern exists over the extent to which such expenditures have produced the intended benefits. At least part of this concern is based around the issue of whether any information technology is accepted by its intended users. Human factors professionals are interested in understanding the determinants of acceptance and ensuring new designs are built and implemented so as to minimize resistance. This concern has extended the traditional ergonomic concern with usability, or ability to use, to cover acceptance, or willingness to use.

2. Defining and studying acceptance

User acceptance can be defined as the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support. Thus, acceptance theorists are less concerned with unintended uses or non-discretionary use of technologies and more interested in understanding the factors influencing the adoption of

technologies as planned by users who have some degree of choice. By developing and testing models of the forces shaping user acceptance, human factors researchers seek to influence the process of design and implementation in a manner that will minimize the risk of resistance or rejection by users.

The scientific concern with user acceptance is comparatively recent, since traditionally, developers and procurers of new technology could rely on authority to ensure that technology was used, at least in many industrial/organizational contexts. However, current working practices, as well as the large market for leisure and educational applications of information technology have enabled greater discretion among users thus increasing the need to determine the dynamics of acceptance.

The literature on acceptance is broad, ranging from case studies of accepted technologies, to the individual psychological characteristics of acceptors or resistors (see Dillon and Morris, 1996 for a detailed review of various theories and models of user acceptance). Each facet of this literature can provide us with some understanding of what makes users accept or reject a system but, since the issue is complex, it is unlikely that a single-variable explanation can be derived of the level of acceptance any information technology will receive among its intended users. For present purposes it makes sense to consider the evidence on the characteristics of the accepted (or rejected) technology separately from the evidence on the characteristics of the accepting (or rejecting) user, before reviewing the interplay of both these factors in current models of acceptance.

3. Characteristics of acceptable technology

According to Rogers (1995) innovation diffusion theory, five characteristics of a technology determine its acceptance:

relative advantage (the extent to which it offers improvements over available tools),

compatibility (its consistency with social practices and norms among its users),

complexity (its ease of use or learning),

trialability (the opportunity to try an innovation before committing to use it),

observability (the extent to which the technology's gains are clear to see).

Numerous diffusion studies have demonstrated that innovations affording relative advantages, compatibility with existing practices and beliefs, low complexity, potential trialability, and observability, will be more extensively and rapidly accepted than an innovation with the opposite characteristics. In particular, three of these characteristics seem to have the greatest influence: relative advantage, compatibility and lack of complexity. While the diffusion model has broad appeal, there are concerns that the characteristics Rogers lists are too loosely defined to provide a sound basis for a complete theory.

The importance of complexity and trialability have long been raised in the HCI (Human-Computer Interaction) literature where these concepts find resonance in the literature on usability and user evaluations (e.g., Nielsen, 1993). Usability is frequently linked to certain qualities of the user interface that are under the control of the designer and HCI professionals place great emphasis on ensuring, through systematic usability evaluations, that users can operate a technology effectively, efficiently and satisfactorily. However, HCI research has concentrated less directly on the concept of acceptability or adoption of new technology, making the plausible assumption that usability is a prerequisite of acceptance.

Shackel (1991) is one of the few HCI researchers to make explicit the link between usability and acceptability. According to his formulation, an acceptable system is one that

appropriately satisfies the requirements of its users for utility, usability, and cost. These attributes can be easily linked with Rogers five characteristics showing a close overlap between two distinct perspectives. However, while ability to use any technology is obviously necessary, it is not sufficient to ensure acceptability, and many technologies that are demonstrably usable are never accepted by the target users.

4. Characteristics of accepting users

Many researchers have attempted to identify psychological variables that distinguish users who accept or reject technologies. In a meta-analysis of research, Alavi and Joachimsthaler (1992) suggest that the most relevant user factors determining technology acceptance are cognitive style, personality, demographics, and user-situational variables.

Cognitive style refers to the characteristic ways in which individuals process and use information and can be seen in information processing terms as a stable pattern of handling incoming stimuli and formulating responses. More than one hundred different dimensions can be found in the literature, although a core cluster accounts for the majority of the work on this topic. To date however, few cognitive style dimensions have been shown to predict user behavior with technology reliably.

Personality traits such as need for achievement, degree of defensiveness, locus of control, and risk-taking propensity are frequently proposed as important predictors of acceptance. The literature on this topic tends to blur the distinction between personality and cognitive style and the results of studies into such traits have equally failed to yield significant insights.

Among the demographic variables that have been studied, age and education have been shown to influence system use in some contexts. As expected, higher educational attainment and lower age both seem to influence use positively, but the relationship is

weak. Coupling demographic variables with contextual knowledge improves matters substantially and variables such a training, experience, and user involvement, correlate well with acceptance of new technology. Alavi And Joachimsthaler (1992) found that the broad group of user-situational factors were more important than individual difference variables.

Innovation diffusion theory also suggests that factors at the level of the individual user are important. Rogers (1995) divides technology or innovation adopters into five categories depending on their speed of uptake: innovators, early adopters, early majority, late majority, and laggards. Rogers plots these categories over a normal distribution where the division between early and late majority is viewed as the mean, and thus laggards and late adopters constitute 50% of the population. Rogers estimates that early adopters and innovators (approximately 16% of the population according to his theory) are more likely to manifest risk-taking, adventure seeking personalities as well as being wealthier and more educated than the norm.

Thus, there is some agreement on the individual and situational factors influence the acceptance of new technologies but the weight of evidence suggests context might be more important than personality or individual psychological factors alone.

5. Modeling the process of acceptance

While the identification of core technological and psychological variables underlying acceptance has provided some insight, few human factors researchers have attempted to link both sets of variables explicitly into a unified theory for design and implementation purposes. The most important theoretical work in this area however has involved socio-cognitive analyses of the dynamics of user action. Models of acceptance have emerged from this work which place emphasis on the attitude of users, and in so doing, seek to

predict long-term user acceptance by measuring early affective responses to any new technology.

Of these models, the most widely cited is Davis et al (1989) Technology Acceptance Model (TAM). TAM predicts user acceptance of any technology is determined by two factors: perceived usefulness and perceived ease of use. Perceived usefulness is defined as the degree to which a user believes that using the system will enhance his or her performance. Perceived ease of use is defined as the degree to which the user believes that using the system will be free from effort. According to TAM, both perceived usefulness and perceived ease of use have a significant impact on a user's attitude toward using the system.

Davis' research shows that TAM can explain approximately 50% of the variance in acceptance levels for many routine office applications, and the results from several studies of TAM indicate that usefulness is the most important predictor of use, explaining significantly more variance than ease of use ratings by users. Impressively, TAM has been widely applied across different application types with consistent results. Furthermore, it is easy to administer since it involves little more than asking users to provide ratings of agreement/disagreement to a series of short statements such as Learning to use this application would be easy for me. However, research on TAM is typically based on a single time period when users are exposed to a ready-made system. This makes it useful for choosing between competing technologies at the implementation stage but less applicable in the early stages of design where designers are trying to determine how best to design a technology so that it will prove acceptable.

6. Designing and implementing acceptable technologies

While significant inroads have been made into the determinants of user acceptance, there remains the tricky issue of applying these insights in the design process to ensure the resulting technologies are likely to be accepted. This poses the joint challenge of determining acceptance before any technology is fully developed and then implementing it in a manner that supports uptake.

One cannot simply rely on models such as TAM since these require the user to experience the technology in order to formulate their perceptions. To date, little work has been carried out on the reliability and validity of TAM scores for early prototypes. Furthermore, it is a fundamental tenet of most organizational theories that the collective response to a new system in any working or social environment is likely to be determined by more than the isolated, individual ratings of the members.

Within the user-centered systems design tradition of HCI emphasis is placed on the early and continuous involvement of users. Primarily this is to serve as testers of prototypes and to provide insights into task and work practices that need to be supported by any technology. Even if a technology is engineered to be highly usable, and be shown to be so through formal testing, there exists no guarantee that this will lead to acceptance.

Theorists from the socio-technical systems tradition such as Eason (1988) argue that information technologies are embedded in working practices and that these practices manifest a network of social relationships such as cooperation among users, management relationships and so forth. Accordingly, any technology cannot be fully analyzed or understood in terms of usability where this is conceptualized in isolation of the goal-oriented organization or work context it is intended to support. In order to jointly optimize both the social and technical attributes of any organization, allowance must be taken at the design level of the social dynamics of any organization or group within it

Socio-technical systems theory has given birth to a framework for technology design that emphasizes the analysis of all stakeholders, not just the direct users of a technology, the formation of planning groups to oversee the design, the performance of prototyping exercises, and the analysis of likely impact the technology will have on the organization. The intention of such a design process is to avoid unpleasant side effects in working practices (which would lead to resistance) and to ensure as much a social solution as a technical solution to the computing needs of an organization.

Eason (1988) views acceptance in terms of two competing forces: control and enhancement. Control factors are those that impose rules or structures upon the users, thereby removing autonomy (control over their own actions) from them. According to socio-technical thinkers, working group autonomy is to be encouraged since it is considered to increase satisfaction and long-term performance. Among the control issues raised with respect to technology design are: access, reliability, confidentiality, monitoring, pacing, stress, social contact. Low or high presence of certain factors (e.g., low reliability, high pacing) with the introduction of a new technology is likely to reduce the users' perception of control and thus increase the risk of resistance.

Enhancement factors include sense of mastery, growth of knowledge, discretion, ability to act informally, requirement for certain skills, and enabling worker cooperation. These factors should all be maximized as appropriate for the context (though skill requirements are not to be inherent for certain situations). A technology that is designed to support such factors is likely to increase user acceptance in an organization.

To date there has been little controlled study of the importance of such control and enhancement variables. Socio-technical researchers tend toward case studies of designs and their implementation rather than controlled experiments rendering specific and individual weighting of control and enhancement factors problematic. However, this

perspective offers insights that might prove amenable to further research which moves us beyond the search for single technological or user variables.

7. Summary

Determining user acceptance of a system is a difficult but important part of human factors research and application. While there is currently no complete theory or model that explains and predicts acceptance, there is an emerging understanding of the key variables in the technology, the user and the implementation process that affect acceptability. To be accepted, a technology must satisfy basic usability requirements and be perceived as useful by its intended user community. User experience and training will impact acceptance levels as will the manner in which the technology is implemented to contribute to organizational goals and working practices.

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Index Terms

User acceptance: theories and models, user resistance, user adoption,