2004

Build It and They Will Come...Or Will They?: An Investigation Into the Phenomena of Technology Acceptance

B. Janz

Mark N. Frolick
Xavier University

J. Simon

Build It and They Will Come…Or Will They? An Investigation Into the Phenomena of Technology Acceptance

3 AUTHORS:


Brian D. Janz
The University of Memphis


Mark N. Frolick
Xavier University

Judith C. Simon
The University of Memphis

Build It and They Will Come…Or Will They? An Investigation Into the Phenomena of Technology Acceptance

Brian D. Janz
The University of Memphis

Mark N. Frolick
Xavier University

Judith C. Simon
The University of Memphis

Why do users of technology, when faced with new applications that seemingly have everything to offer in terms of simplifying work processes, shortening cycle times, and improving customer service decide to reject them? This paper seeks to explore in more depth the phenomena of user acceptance and to illustrate the dynamics of user acceptance by way of a descriptive case study of a large company that faced such a challenge. Through the use of two theoretical models, we learn that if the proposed technology solution does not fit the people or the problem or if the people who are expected to use the system do not perceive it as easy to use as well as useful, it will not be accepted.

By definition, technology is an artifact that is applied by individuals or organizations to achieve a commercial or industrial objective. By extension, information technology (IT) pertains to those artifacts that provide for more effective use of information to achieve commercial or industrial objectives. As such, in most efforts to optimize business processes, reduce costs, and improve customer service the application of technology is viewed as a positive contribution. Often, however, this "push mentality" is met with resistance by the user population who refuse to adopt new technologies and applications. A users' acceptance of new technologies is one of the most critical issues in whether or not a technology is ultimately used. Thousands of systems have been developed by IS organizations that have not been adopted by its users. A recent CIO Magazine article suggests that users are often the victims of systems that do not adequately meet their needs and further suggests by way of data from the Standish Group, that faulty software costs businesses $78 billion per year (Levinson, 2001). As a result, users often refuse to use such systems. It is the aim of this paper to explore in more depth the phenomena of user acceptance and to illustrate the dynamics of user acceptance by way of a descriptive case study of a large company that faced such a challenge.

Background and Need for the Study

The organization involved in this study, The Biotronics Corporation[1], is a medical technology company that manufactures and sells a wide range of products including devices used in vascular and cardiac surgery. The company has over 20,000 employees and conducts business in over 100 countries.

The focus of the study was Biotronics' decision to pursue the development of a new technology-based system for their sales force. The sales force automation system would be designed to assist Biotronics sales personnel in their effort to sell customized medical products for hospital surgical personnel. With this system, initial product configurations could be done early in

[1] The name of the organization in this article has been changed to protect the anonymity of the company.

the sales call process with the use of a laptop computer and appropriate software. This system would facilitate the immediate communication and confirmation between the two parties during the sales process as well as provide digital product information that could then easily be shared with the organization's immediate supply chain – their product design, strategic sourcing, and manufacturing areas.

One of the main problems encountered during sales calls that gave rise to this perceived need for a sales application involved the uniqueness of each of Biotronics' product design required by individual customers. In this particular study, the product line of interest was the "perfusion circuit," or in Biotronics' terminology, the custom perfusion system (CPS) – the series of valves and tubing that connect a surgical patient to a heart/lung machine. The primary customers for the product line involved in the study were perfusionists, those medical professionals who monitor and operate heart/lung machines during open-heart surgical procedures.

Traditionally, Biotronics sales representatives met with perfusionists and developed hand-rendered sketches of a CPS for that particular perfusionist. Variations on CPS design exist for several reasons including the overall setup of a particular operating room, the space limitations between the heart-lung machine and the patient, and, perhaps most importantly, the personal requirements of the perfusionist. For example, a perfusionist may have specific design guidelines that are based on the training that he or she received in circuit requirements or personal preferences for specific types/lengths/configurations of tubing. In some cases, the ego of the perfusionist becomes a design factor in that certain hospitals or medical groups have their "own" designs that differ from other hospitals' designs for no apparent reason other than they are touted to be "better than the other guys' circuits."

Existing Custom Perfusion System Design Process

Given that the non-automated configuration process at Biotronics required 12 to 16 weeks from an initial sales call to receipt of the product in the hospital, one purpose of the study discussed here was to evaluate what potential improvements to the non-automated process could be gained with the sales force utilizing an automated perfusion circuit configuration system. For example, this new system might shorten the cycle time in providing a product that more accurately fit the customer's needs, and at the same time might reduce the time, materials, and costs associated with an extended product pipeline.

The entire configuration process was analyzed: from generating a request for a CPS through the completion of the order and receipt by the customer. The existing CPS process is described in more detail below.

Specification Request Generation. The two primary sources of requests for a specification are (1) sales representatives, and/or (2) perfusionists. Sales representatives typically meet with perfusionists to obtain the details needed to configure a CPS. In addition, perfusionists may provide a sales representative with a bid request received from a Biotronics competitor. These meetings took place in numerous locations and in numerous ways, e.g., face-to-face in offices or operating rooms, through telephone conversations, etc. It is also important to point out that for the most part, the sales force was non-technical in nature. In other words, while they fully understood the technical specifications of their product line, they were not information technology zealots.

These requests are then sent to the Custom Pack Coordinator (CPC) at Biotronics, and are most often sent by email (80%), with the remainder sent by fax, US Postal Service, or phone call.

Specification Request Review. After receiving the CPS request, the CPC then reviews each CPS configuration request for completeness and buildability. If a request is deemed incomplete or has other potential design problems, the sales representative is called to obtain additional information. Otherwise, the CPS configuration request is assigned a catalog number. The CPC then creates an AutoCAD drawing, which takes, on average, approximately 4 hours to complete. The drawing is then reviewed for quality control, which typically takes 30 additional minutes.

Sample Product Issues. At times, the perfusionist may want an actual sample of the CPS prior to deciding to purchase ("kicking the tires" so to speak). In these cases, requests for sample circuits are sent from the CPC to the Biotronics production area where a non-sterile sample would then be built and sent to the customer. If the sample circuit is then deemed acceptable by the perfusionist, it is ready for pricing. If the sample is not acceptable and additional changes are requested, the revision request is sent to the CPC for further review and modification (note: up to $250,000 is spent on samples that do not meet customer needs). The sales representative's signature is required on all revision requests. It is important to note that due to miscommunication, customer changes in design, preferences, etc., an average of three revision cycles is typically required before the product is acceptable for pricing.

Pricing. If the customer requests no sample or if the sample has been accepted, a pricing request is sent to the sales administrator. Once the pricing is completed, the sales representative meets with the customer. Once the customer accepts both the samples and pricing, the CPC creates production specifications and compiles a bill of materials. The bill of materials is then forwarded to Quality Control and Sales Administration for a second, final pricing.

Production. After the customer accepts the circuit configuration and pricing, the order is either classified as "build-to-order" or "build-to-stock." For build to order, the orders go through a routing process where material and component requirements are assessed, parts are either ordered from the warehouse or suppliers, and the order finally goes to manufacturing. For stock orders, the sales representative requests a Stocking Agreement from the CPC. The CPC faxes this agreement to the sales representative or customer for signature. Once the signed agreement is received, the CPC generates and sends a Planning Maintenance Form to Planning. Planning inputs the stocking level and stocking agreement, and orders then go to the routing process like the build-to-order orders. Figure 1 is a process flow chart depicting the details of this process.

User Acceptance Concerns

The sales-design-pricing-build process discussed in the last section could be characterized as communication intensive. That is, throughout all of the sub-processes, there is a high degree of information sharing and communication between process participants. Much of the communication is iterative in nature – it tends to loop back and forth as process participants seek to verify the correct specifications and other design details – and also manual in that the design starts with a graphical hand-rendered drawing that has to be communicated verbally (either through voice communication or email), and then converted back to a graphical design. As is often the case for such processes, the time required to work the process is long, and the quality of the communication tends to be error-prone. Delays and errors add time and cost to any process, and typically customer service suffers as a result.

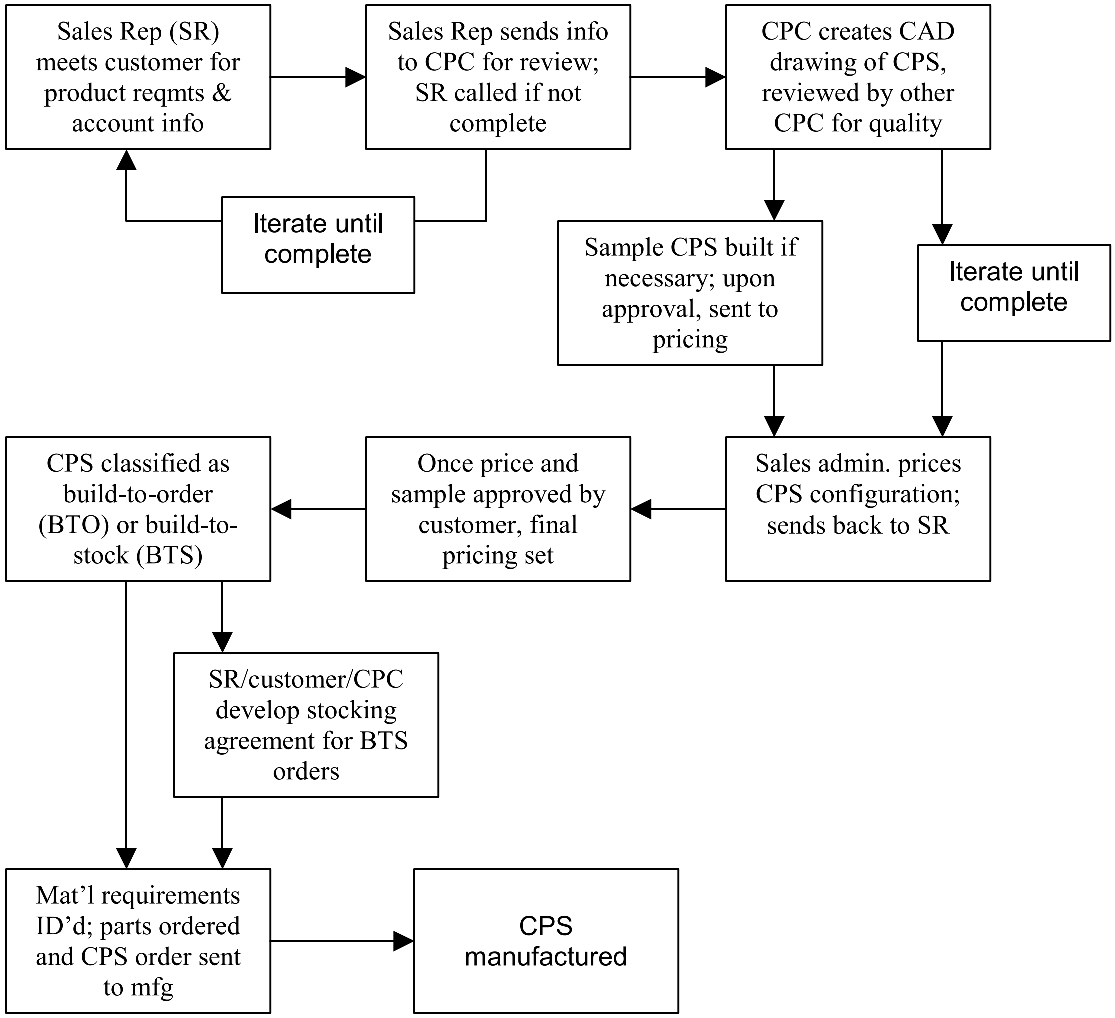

Figure 1. CPS Sales and Design Process

Thus, it seemed apparent to the Information Systems (IS) department at Biotronics that information technology in the form of an automated and graphical sales tool would help to address the time and quality concerns by streamlining communication and by getting the CPS design in an electronic format as early as possible in the sales process. It was then reasonably assumed that the time and quality-related benefits would translate to cost efficiencies throughout the supply and manufacturing chain and ultimately would lead to increases in customer service and satisfaction. However, these results were not to be. Once developed, the majority of the sales force rejected the automated sales tool outright. This counter-intuitive situation is the focus of the remainder of the article. That is, why do users of technology, when faced with new applications that seemingly have everything to offer in terms of simplifying work processes, shortening cycle times, and improving customer service, decide to reject them? In answering this question, two detailed areas will be explored:

1. How important is it that new technologies fit the task they are designed to improve?
2. Given a new technology's fit to the task, will end users (in this case sales representatives and hospital personnel) be willing to use it?

Although these questions seem basic and almost rhetorical, we will point out that they are often overlooked, and when this happens, counter-intuitive results may ensue.

Task/Technology Fit

User evaluations of information systems (IS) have been a recurring topic in IS research. Positive user evaluation of the system often translates to more effective use of the system and improved job performance, whereas negative user evaluation often translates to less effective use or complete abandonment of system use and decreased job performance. Therefore, understanding user assessments of technology helps predict the use of the system and evaluate the quality of the system.

Goodhue and Thompson (1995) found that for an information technology to be effective on individual performance it not only needs to be utilized but it must also demonstrate a good fit with the tasks it supports. Based on this rationale, the Task-Technology Fit (TTF) model was developed to better explain the relationship between technology and the task that it supports. The model is used to evaluate the quality of an organization's overall information systems and services rather than individual applications. The general model of TTF is presented in Figure 2.

As the model suggests, users' evaluation of TTF is determined by their assessment of their task characteristics, individual characteristics, and information systems and services. The model hypothesizes that the correspondence between information systems functionality and task requirements leads to positive user evaluations. As the task characteristics or the abilities of the users change, the information systems and services must change accordingly to meet the new needs. Therefore, task characteristics and individual characteristics not only have a direct effect on their evaluations, but also an intervening effect on the relationship between

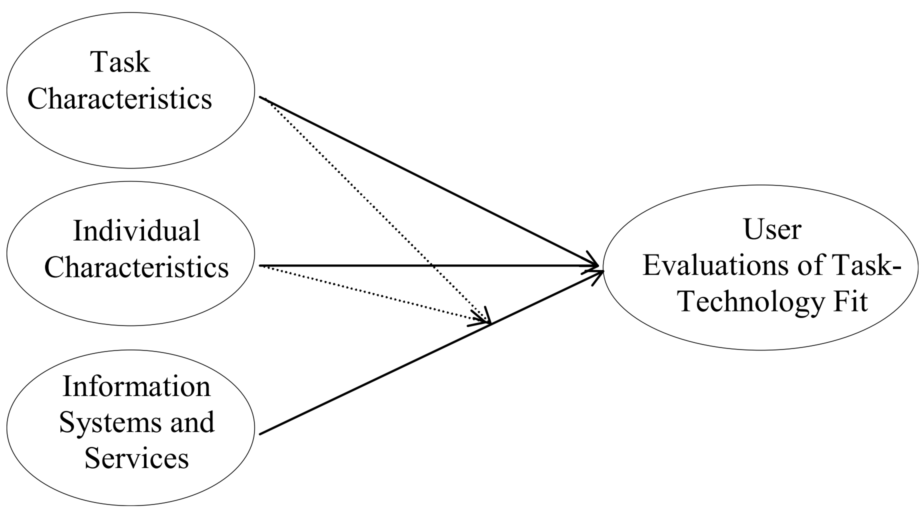

Figure 2. Task-Technology Fit

the characteristics of the systems and user evaluation.

TTF can be used as an effective evaluation and diagnostic tool for specific technology solutions or for an organization's overall information systems and services. Since higher TTF would result in better performance, Goodhue (1995) proposed that TTF could be used to measure IS success. For an information system to be successful, it must demonstrate a good fit with the task it supports. Therefore, when attempting to develop technologies that will ultimately be embraced and used by the users, developers should not only focus on developing great user interfaces, but they should also tend to TTF issues as well (Mathieson and Keil, 1998). To that end, system developers must have a good understanding of the tasks the system will support and the end users who will use the system. This can be achieved through thorough interviews with users, observing the user performing the tasks, and other information requirements determination (IRD) techniques[2]. Second, the information system must be designed around the task characteristics and user characteristics in order to be successful. Finally, as the task characteristics and users' abilities change, timely modifications to the system must be made to maintain a high TTF.

In the next section we discuss the issue of user acceptance in more detail.

The Technology Acceptance Model

System use is one of the most important dimensions in measuring information systems success. The link between the adoption of information technology and increased individual and organizational performance is widely recognized across various industries. Information technology must be accepted and used by end users in order to exert its influences on performance. Determining what motivates end users to accept and use a particular information technology is another area that has received a great deal of attention from MIS researchers.

One of the most influential research models in studies of the determinants of information systems acceptance is the Technology Acceptance Model (TAM) introduced by Fred Davis (1986). TAM is designed specifically for explaining and predicting computer acceptance by end users. The general model of TAM is presented in Figure 3.

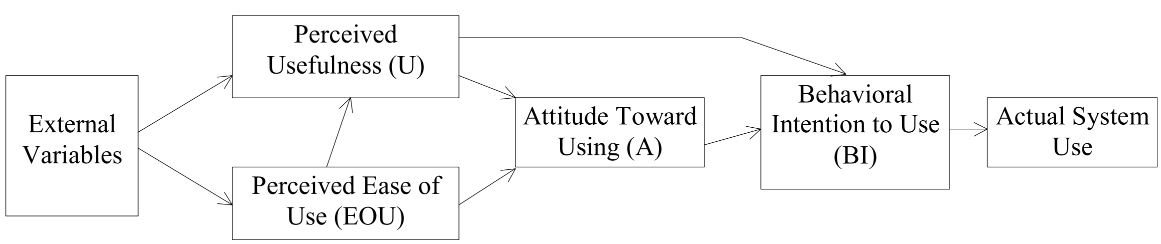

Figure 3. Technology Acceptance Model (TAM)
(Source: Davis et al. 1989)

[2] A good example of interviewing techniques is presented in "Human Perception: A Challenge to Organizational Process Optimization," by Janz, Frolick, and Wetherbe, as published in *Cycle Time Research,* Volume 6, Number 1, 2000.

TAM hypothesizes that a person's behavioral *intention* to use a particular information technology is the immediate determinant of that person's actual system use. The intention to use is in turn influenced by the person's *attitude* toward using the technology. Attitude refers to the person's judgment as to whether using the technology is good or bad. A positive attitude toward use will lead to stronger intention to use the technology. Attitude is a function of the perceptions formed by the person in terms of how *useful* they see the technology being and how *easy to use* the technology is. Perceived usefulness 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 context," and perceived ease of use refers to "the degree to which the prospective user expects the target system to be free of effort" (Davis et al., 1989). Clearly, the task-technology fit described earlier is very closely related to perceived usefulness and ease of use. Perceived usefulness and perceived ease of use are determined by external variables, for instance, user interface design, users' educational background, etc.

TAM provides great insights as to why people choose to use a particular information technology or not. Perceived usefulness and perceived ease of use are the two key issues that motivate people to accept the information technology. If people believe that using the technology will improve performance, reduce effort, or save time, they are more likely to hold a positive attitude toward using the technology. Similarly, if they believe that they can use the technology without much difficulty, the technology is more likely to be accepted. When perceived usefulness and perceived ease of use conflict with each other, the person's attitude toward use depends on the relative importance of these two issues. For example, if a certain technology is extremely useful in a person's work but requires an enormous amount of training to become skilled in using it, there can be a problem. However, if the person values usefulness over ease of use, he or she is likely to use the system, and vice versa.

The external variables in the model are of great interest to system developers. These external variables determine a user's perceived usefulness and perceived ease of use, which eventually influence system use. The model suggests that in order to increase the potential use of the system, system developers need to focus on those features that enhance a user's perceived usefulness and perceived ease of use. The system must be designed to not only include functions that are highly useful, but intuitive as well.

The model also implies the importance of user education and training. User computer self-efficacy is one of the determinants of perceived ease of use (Venkatesh and Davis, 1996). This suggests that training aimed at raising a computer user's self-efficacy will be effective in increasing the user's acceptance of the technology. Training that aims at increasing users' understanding of various features of the system will allow users to realize the potential usefulness of the system in their work.

If an organization is considering the adoption of a new technology but is not sure about whether the technology will be accepted and used by end users, both TTF and TAM can be used as the basis for an evaluation of the potential acceptance of the technology. First, the developers of the technology need to understand the nature of the task at hand to insure that the proposed technology provides a good fit. To do this, developers need to understand the nature of end users' work and adapt the technology to be highly useful to end users. Second, user training and education targeted at enhancing end users' understanding of the technology is crucial. Finally, user education on general computer knowledge, which will increase end users' computer self-efficacy, is equally important in ensuring that they accept new technology with greater confidence.

Analysis: Why Reject the System?

Armed with the understanding provided by the TTF and TAM models, it is instructive to analyze why the sales force for Biotronics refused to adopt a technology that promised benefits relating to time, quality, and customer service.

The Biotronics IT department team that studied the existing sales order/configuration process recommended that the sales force adopt an application developed on a Visio® software platform. Visio®, a WYSIWYG (i.e., "what you see is what you get") graphics package, can be used to quickly develop electronic plans that can include textual data to support the graphics. For example, not only can widget "ABC" be quickly drawn with Visio®, but data relating to vendor, price, and product description can be "attached" to the graphic. These relationships can be pre-built and stored on the sales force's system so that all they would need to do is select widget "ABC" from a Visio® template, and all associated data would accompany the graphic. A full-blown graphical configuration could then automatically generate an overall CPS price and parts list. The Visio® system was envisioned by the IS organization to be used by the sales force as an effective sales tool when communicating with their customers. To help the sales force see the benefits of such a system, a prototypical demonstration system was developed.

The fact that the Visio® system was rejected by the majority of the sales force was most likely due to a large combination of reasons, with each sales representative having his or her own unique set of reasons for not adopting the system. The TTF model suggests at least a few areas that might have led to the non-adoption. First, the TTF model suggests that a good understanding of the task at hand needs to be achieved. In the case of Biotronics, the study team accompanied a sales person on a sales call with a perfusionist. While this call was held in the perfusionist's office and a laptop solution could have been used, not all meetings occur in such locations. At times, the only time a sales person can talk to the perfusionist is during the surgical procedure. In these cases, the laptop solution would not be appropriate for reasons of sterility, space, and/or attentional requirements. Another characteristic of the task is that it is often time-constrained. Within a few minutes, a sales person and a perfusionist can hand-draw and edit a potential CPS design. Although the Visio® solution was relatively easy to use, it could not meet this kind of time challenge.

The second "fit" area suggested by the TTF pertains to the characteristics of the services and systems provided by IS. This is perhaps a more subtle area to analyze. Up to the point of the Visio® application, IS did not have that much experience in working with the sales force. After early meetings to understand system requirements, most of the follow-on development was done by IS without much communication with the sales force or the CPS design organization. This lack of participation throughout the development process could be a significant reason for the resistance encountered. To add to this, certain members of the user group mentioned that they felt the new application was being pushed on them, and the CPS design department did not see a real need to adopt the new technology since they felt they were doing an acceptable job already.

Characteristics of the individual users are the third area that the TTF model suggests for further inspection. Because individual characteristics are closely related to individual perceptions as outlined in the TAM model, they will be addressed together. In the Biotronics case, this is perhaps one of the most enlightening areas to study when attempting to understand the non-adoption of the Visio® system. The sales force was for the most part, made up of sales professionals with many years of experience. In terms of technology, they would not be categorized as “early adopters” or a group that embraces new technologies when they emerge. They, as a group, would use technology if they absolutely had to, but would not look for opportunities to adopt it. When faced with the demonstration system, it was perceived to be difficult to learn and use, and it was not clear to them how the laptop solution would make their lives better. In other words, the technology did not “fit” the users, and the perceived ease of use (TAM’s “EOU”) and usefulness (TAM’s “U”) were not gauged to be high. TTF would propose that the users would give the technology a low evaluation. TAM would suggest that the users’ attitude towards the new system would be negative, and the subsequent intention to use (and ultimate use of) the Visio® system would be unlikely.

Discussion

The Biotronics case study presented here is instructive in helping to understand why certain applications are adopted or not. In Biotronics’ case, the automated custom perfusion system using Visio® was not adopted. The perspectives offered by the Task-Technology-Fit and the Technology Acceptance Models suggest that the primary reason was that the company was never able to convince their sales force that this system would improve their work life or that of their customers. Although the Visio® solution was quite good from a purely technical perspective, it was not perceived to be a positive change by the sales representatives or the hospital staff. This common problem provides emphasis for the fact that considerable work must be done throughout development of a new system to involve the eventual users so that they will understand the purpose of the technology and the ways in which it will benefit them. This also provides opportunities for the IS organization to develop a strong relationship with the user community and to further understand the task characteristics as well as the idiosyncrasies of their users. If the proposed technology solution does not fit the people or the problem, or if the people who are expected to use the system do not perceive it as easy to use as well as useful, it will not be accepted, money will be spent unnecessarily, and the benefits that typically accrue to technology users will not be enjoyed.

References

Goodhue, D. L., "Understanding user evaluations of information systems," Management Science (41:12), 1995, pp. 1827-1844.

Goodhue, D. L. and Thompson, R. L., "Task-technology fit and individual performance," MIS Quarterly (19:2), 1995, pp. 213-236.

Mathieson, K. and Keil, M., "Beyond the interface: ease of use and task-technology fit," Information & Management (34:4), 1998, pp. 221-230.

Davis, F. D., "A technology acceptance model for empirically testing new end-user information systems: theory and results," doctoral dissertation, MIT Sloan School of Management, Cambridge, MA, 1986.

Davis, F. D., "Perceived usefulness, perceived ease of use, and user acceptance of information technology," MIS Quarterly (13:3), 1989, pp. 319-340.

Davis, F. D.; Bagozzi, R. P.; and Warshaw, P. R., "User acceptance of computer technology: a comparison of two theoretical models," Management Sciences (35:8), 1989, pp. 982-1003.

Levinson, M., "Let's stop wasting $78 billion a year," CIO Magazine, October 15, 2001.

Venkatesh, V. and Davis, F. D., "A model of the antecedents of perceived ease of use: development and test," Decision Sciences (27:3), 1996, pp. 451-481.

Brian D. Janz, Ph.D., is an Associate Professor of Management Information Systems in the Fogelman College of Business and Economics and Associate Director of the FedEx Center for Supply Chain Management at The University of Memphis. His research focuses on how information technologies affect organizational strategy, design, and knowledge worker behavior.

Mark N. Frolick, Ph.D. is the Western & Southern Chair in Information Systems at Xavier University. His research, teaching, and consulting have focused on data warehousing, executive information systems, e-business, cycle time reduction, systems analysis and design and the diffusion of information technology in organizations.

Judith C. Simon, Ed.D. is a professor of Management Information Systems and Chair of the Department of Management Information Systems in the Fogelman College of Business and Economics at The University of Memphis. Dr. Simon's research interests include the effects of new technology implementation on various aspects of an organization's people and processes, specifically; decision support systems, collaborative systems, and knowledge management systems.