Technology Acceptance and Performance: A Field Study of Broker Workstations

Henry C. Lucas, Jr.

Valerie Spitler

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Henry C. Lucas, Jr.
Department of Information Systems
Leonard N. Stern School of Business
New York University
44 West 4th Street, Suite 9-67
New York, NY 10012-1126
(212) 998-0814
fax: (212) 995-4228
hlucas@stern.nyu.edu

Valerie Spitler
Department of Information Systems
Leonard N. Stern School of Business
New York University
44 West 4th Street, Suite 9-181
New York, NY 10012-1126
(212) 998-0827
fax: (212) 995-4228
vspitler@stern.nyu.edu

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Henry C. Lucas, Jr.
Valerie Spitler

Stern School of Business
New York University

ABSTRACT

We develop a model to predict 1) the use of a multifunctional, broker workstation with a windowed interface and 2) the relationship between workstation use and performance. Brokers and sales assistants in the private client group of a major investment bank use this workstation as an integral part of their jobs. Our model explains some of the variance in their usage, intended usage and performance, but the variables that are most salient in the model differ between brokers and sales assistants. There is evidence that low performing brokers use the workstation more than higher performing brokers; the results also suggest that a different type of training may be needed for sophisticated workstations for professionals than for clerical personnel learning to use transactions processing systems. We believe it is important to understand the acceptance of technology and the relationship between system use and performance if firms are to obtain a return from investing in information technology.

Over 50% of capital investment in the U.S. is for information technology (*The New York Times, December 3, 1995)*; *BusinessWeek* estimates that there are 63 PCs per 100 workers in the U.S. (including machines at home) and others have calculated that one in three U.S. workers uses a computer on the job. One brokerage firm is investing over $100 million in new technology for its brokers. There will be little return from information technology (IT) if workers fail to accept it or to fully utilize its capabilites.

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How can managers and developers of advanced technology predict its acceptance and likely success when making investment decisions?

This paper develops a model to predict the acceptance and use of a workstation designed for private client brokers at a major investment bank. These brokers work with sales assistants to provide investment services for high net worth customers of the bank. The model also predicts performance in this complex work setting. In comparison with many past studies of technology acceptance and performance, the present study features:

- A field setting in a real organization,
- A multifunctional workstation with a windowed interface and network technology,
- Complex tasks which are supported by the workstation,
- Users for whom the technology is an integral part of their work,
- Users who have different strategies for success and whose performance varies widely,
- Two groups of users, brokers and sales assistants, performing different tasks using the same technology,
- The opportunity to measure preformance at the level of the individual.

PRIOR RESEARCH

There have been a number of studies of implementation and the acceptance of new technology; reviews and summaries of some of these studies may be found in Swanson (1987) and Lucas, Schultz and Ginzberg (1990). Goodhue (1995) has presented empirical data on the Task-Technology Fit model. Davis' Technology Acceptance Model (TAM), based on the Theory of Reasoned Action developed by Fishbein and Ajzen (1975), has been widely applied. Because of TAM's strong base in theory and the relatively large number of studies which support it, this model provides the starting point for building our research model relating technology acceptance and performance.

In the original test of TAM (Davis 1989), high levels of Perceived Usefulness and Perceived Ease of Use predicted Intentions to Use information technology. Davis found that Perceived Ease of Use acts primarily through Perceived Usefulness to influence Intentions to Use. Davis' results supported his model (1989); several other studies also provide evidence for TAM. See Table 1 in the Appendix for a summary of this research. Davis, Bagozzi and Warshaw compared a model based on the Theory of Reasoned Action with TAM and found mixed results for both models, though there was support for the key variables of Perceived Usefulness and Perceived Ease of Use and their positive relationship with behavioral Intentions to Use a system (1989). Mathieson (1991) also compared TAM with the Theory of Planned Behavior (TPB) and found that both models predicted Intention to Use well, but that TAM was slightly better from an empirical view.

Taylor and Todd (1995) looked at TAM and the Theory of Planned Behavior in a longitudinal study of a resource center; they concluded that a decomposed Theory of Planned Behavior provided more insights than TAM, though TAM received support from their data. In another study drawn from their data (Taylor and Todd 1995a), these same authors found that TAM, modified to include subjective norms and perceived behavioral control, performed well in predicting acceptance for both experienced and inexperienced users. Straub et al. (1995) used TAM to compare self-report and computer monitored voice mail usage in a field setting. Szajna (1996) found that a revised TAM, dropping attitudes from the model and making a slight change for pre versus post-implementation, predicted usage, but that adding an experience component is a worthwhile extension of the model. Szajna also recommends that measures of actual

usage may work better than self-report measures, at least when looking at the acceptance of e-mail. Adams, Nelson and Todd (1992) examined the psychometric properties of Davis' perception scales; they conclude that these two scales are valid and reliable.

THE RESEARCH MODEL

We have found more studies of TAM than any other acceptance or implementation model. This fact, combined with a strong basis in theory, led to the selection of TAM as the core of our model of technology acceptance and user performance. The original TAM includes the variables Perceived Usefulness, Perceived Ease of Use, Attitudes, Intention to Use and Usage. Higher levels of Perceived Usefulness and Perceived Ease of Use predict favorable Attitudes which, in turn, predict Intentions to Use. Intentions to Use predict actual Usage.

Almost all of the studies of TAM and similar models have employed college students in experimental or quasi-experimental research designs. One study of a computer system, used primarily for developing scales, included professionals whose daily job involved the use of technology (Davis 1989). Straub, et al. (1995) conducted a field study, but the technology was voice mail and the purpose of the study was to assess agreement between self-report measures of use and computer recorded use rather than to test TAM directly. Adams, Nelson and Todd (1992) looked at email and voice mail in organizations, but the second part of their study involved students. The technology in these studies has been single function software (eg. a spreadsheet), email, or voice mail instead of a more modern, multifunctional managerial workstation with a windowed interface. While TAM can form the basis for our model, it needs to be extended to

predict acceptance and performance in an actual organization with different types of users who work with a complex technology.

Developing the Model

The objective of the research reported in this paper is to examine acceptance and performance in a field setting with users who have powerful, multifunction workstations and where *the technology is an integral part of work life.* In an experiment assessing students' acceptance of word processing, subjects use generic software in an academic environment where word processing can be very useful. This setting is much different than one in which management is interested in the acceptance of a workstation on the user's desk. The workstation features an array of software applications that can be used in a variety of ways to perform different tasks. A field setting of knowledge workers confronting a workstation on a daily basis is more complex than the environment of most laboratory studies, giving rise to additional variables that influence users.

What theoretical justification is there for our research model? The original formulation of TAM, the Theory of Reasoned Action, past implementation research and theories of task-technology fit are the basis for the model used in this study. Davis describes a class of "external" variables which influence Perceived Usefulness and Perceived Ease of Use. The Theory of Reasoned Action, on which TAM is based, includes social norms as a determinant of behavior. The task-technology fit literature argues that users evaluate systems based on the technology's ability to meet their needs and abilities (Goodhue, 1995). Past research on implementation (Lucas, Ginzberg and

Schultz, 1990), especially related to technology acceptance by brokers (Lucas, 1979), also offers guidelines for extending the model.

Combining theories and past research suggests additional variables for a model that predicts acceptance and performance in a field setting including:

Broker strategy
Perceived system quality
Workload
Broker performance.
Social norms.

Broker Strategy. While the tasks of all brokers are similar, there are different ways to approach the job (Lucas 1979). Consider an office of stock brokers: one broker may feel she can best serve her clients by doing extensive research and disseminating the results to customers to encourage them to trade. This broker would be likely to use the features of a workstation that provided access to research information. A second broker might have a strategy of cultivating social ties so that most of his time would be spent at meals, visiting clients and at social functions; he would have less use for the features of a workstation. The broker's approach to the job, her strategy, affects the degree to which the technology fits her tasks.

Perceived System Quality. The quality of a system is related to whether a user perceives that he or she can accomplish tasks with a workstation. Technology that omits important functions or which features irrelevant ones will not satisfy the user's needs. Also, systems which lack adequate response time or are unreliable inhibit task performance (Goodhue 1995).

Workload. In a laboratory setting one might expect that all students will be confronted with about the same workload in which a word processor might be useful, particularly first-year students in required courses. In the case of broker workstations, there is high variance in the workload for each user. For example, it takes the same effort (number of keystrokes, number of screens) to enter a trade for a hundred dollars as it does for a million dollars. The broker with ten very large accounts confronts a different kind of workload than a broker with 100 average accounts. Different kinds of technology fit differing workloads .

Performance. Organizations like investment banks invest in technology for a number of reasons. For systems like the one studied here, there are a variety of justifications for the investment:

- To reduce costs by making sales assistants more productive, reduce market data fees, and/or consolidate various systems.
- To improve the performance of brokers and sales assistants.
- To impress customers, provide better service and encourage them to do more business with their broker.

The data we were able to obtain make it possible to look at the second reason above for investing in the system, improved performance for individuals.

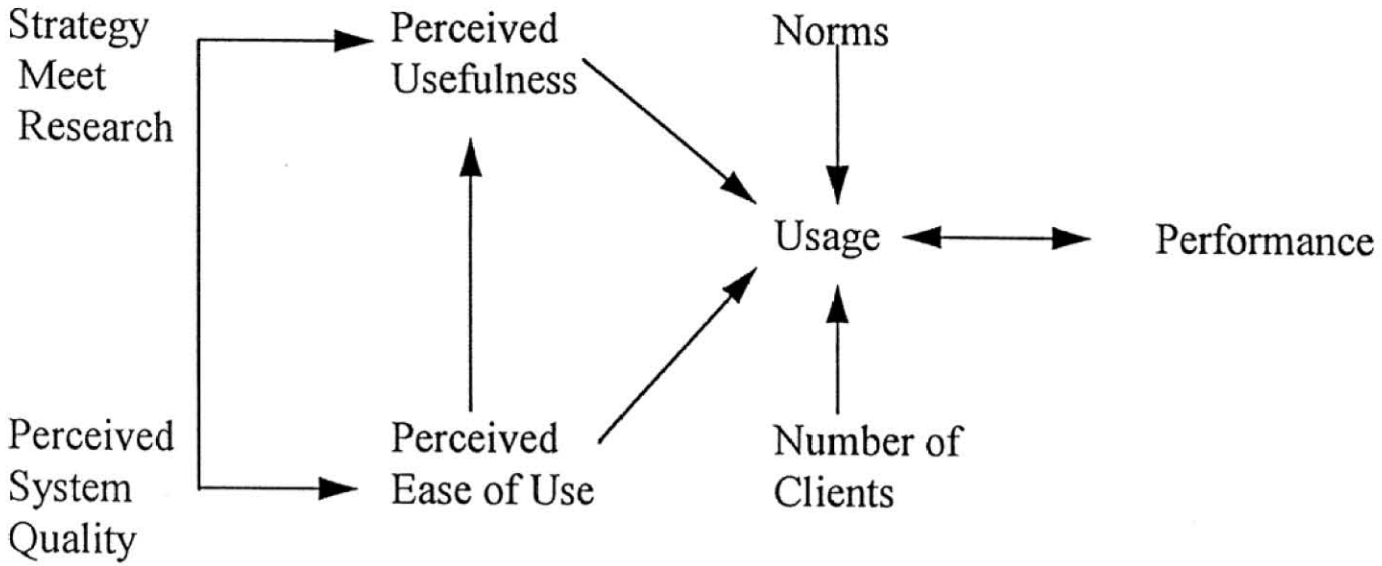
It is possible that technology best fits the needs of the high performing user, or in some instances, the needs of the more poorly performing worker (Lucas 1975). The use of a system could be associated with high levels of performance when the system contributes and supports a worker. In other instances, a person with poor performance may use an information system to diagnose problems and develop a strategy for improving performance.

Social Norms. In addition to the variables associated with the task-technology fit literature, the Theory of Reasoned Action stresses the importance of social norms in predicting behavior. "According to our theory, the more a person perceives that others who are important to him think he should perform a behavior, the more he will intend to do so. (Ajzen and Fishbein ,1980, p 57)." In a laboratory setting, participants are not subject to the influence of senior management, and may not perceive much influence from their peers. It should be noted that in one empirical study of participation, Hartwick and Barki (1994) incorporated social norms and found only weak associations with other variables. In the current study we hope to learn if social norms are important in a field setting.

The Research Model

Figure 1 presents the model we constructed to study workstation acceptance and performance. The task-technology fit literature hypothesizes that characteristics of the task, technology and the individual contribute to fit, which is indirectly related to perceptions and to usage (Goodhue 1995). Davis believes that other "external" variables act through perceptions of ease of use and usefulness to influence acceptance. Broker strategy and perceptions of system quality fit this category. The broker's strategy will influence her perceptions of the usefulness of a workstation; if she stresses personal contact and meeting with clients, it is reasonable to expect that she will perceive the workstation as less useful than a broker who focuses on research.

Perceptions of system quality are also likely to influence perceptions of ease of use and usefulness. Is perceived quality the same as perceived ease of use and



The Research Model
Figure 1

usefulness? Examining the items that make up the questions used to measure the TAM perception variables, a system quality component is not evident. It is also not clear what influences the formation of the two TAM perceptions. As will be seen in the discussion of measurement scales below, Perceived Quality consists of items which are partially under the control of management and the designer; quality offers a way to influence perceptions of Ease of Use and Usefulness and therefore acceptance, assuming one believes the causal implications of the model.

In the Theory of Reasoned Action, Norms influence behavior, so our model hypothesizes that norms affect usage directly.

Workload is measured in this study by the number of the broker's active clients. Does workload fall into the category of external variables that act through perceptions, or is it directly related to usage? In the case of broker workstations, our observations of broker and sales assistants argue for a direct connection between workload and usage. There is a minimal mandatory level of usage of the workstation which is required to service clients, for example, obtaining stock quotes and entering trades. This usage is directly related to the number of clients, not to perceptions of usefulness or ease of use. More discretionary use of the workstation should also be correlated directly with the number of clients. A broker with a large number of clients is likely to turn to the workstation for conducting research rather than going to more time-consuming, traditional sources, simply because this broker has a larger number of requests to process.

One of the objectives of this research is to examine the relationship between technology acceptance and user performance. Performance is a complex phenomenon.

Our interviews in the investment bank and observations of brokers suggest two broad classifications of brokers based on their performance. The high-performing broker is successful because of his or her ability to serve clients or the ability to attract wealthy clients. This highly compensated broker is unlikely to dramatically change his or her behavior because the risks in doing so are quite high. This person will use the familiar functions of the workstation and may, at least at first, ignore the new options it provides.

The second class of broker is not as successful; this lower performing broker is interested in improving performance and the Workstation is a resource that may help in this process. We would expect this low performing broker to make greater use of the workstation than a higher performing one, especially when the technology is first introduced.

In the task-technology fit model, both fit and usage predict performance. Based on this model and past research on information technology and performance, the model in Figure 1 includes usage as a predictor of performance when a system can contribute to improved performance. There is also an arrow in the figure showing a link between performance and usage based on past studies in which low-performing individuals used a system to find problems and improve their performance (Lucas, 1975).

THE STUDY

Site, Technology and Sample

The data to test the research model came from a sample of brokers and sales assistants at a major investment bank. Groups of brokers and assistants work with "private clients," customers with a high net worth. The brokers' objective is to help

clients manage their assets. This business is valued by the bank because it tends to be stable compared to the volatility the bank experiences in other activities. Both brokers and sales assistants are highly compensated for their efforts.

Brokers provide advice and order execution for a group of clients. Brokers are also constantly seeking new clients to replace those lost to attrition or to the competition. Brokers tend to work in groups of two to four, supported by one or more sales assistants per broker. The job of sales assistants is varied; they maintain account information and serve clients in a number of ways. Some have frequent phone contact with clients and may take on some of the broker's normal duties when the broker is not available.

Prior to the Fall of 1994, brokers and assistants had access to relatively limited information technology. They used a variety of quotation systems and a number worked with their own analytic, word processing and spreadsheet programs on personal notebook and/or home computers. In the last part of 1994, the bank implemented a major new system for the private client brokerage unit. This system includes a Sun workstation for each broker and each sales assistant. The workstation runs a windowed interface with the Unix operating system. The workstations are networked to servers and to the corporate mainframe computer which maintains transactions processing and accounting data.

The workstation has three main applications: market data, office software and mainframe access. Market data includes "snap" stock quotes in real time from the various exchanges, and monitoring functions which signal when an event happens such as a stock hitting a certain price on the NYSE. Market data is a fundamental requirement for brokers and sales assistants who must use it to answer customer queries and execute

orders. The investment bank purchases market data; the market data package includes a series of analytic routines for research, for example, functions to graph stock prices and volumes.

Office applications include three common functions: word processing, spreadsheets and presentation graphics. The bank purchased these applications for Unix; they are similar to Microsoft Office for a PC.

The last major application is access to mainframe data. All information on a