PHYSICIANS' ACCEPTANCE OF WEB-BASED MEDICAL ASSESSMENT SYSTEMS: FINDINGS FROM A NATIONAL SURVEY

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Abstract

Providing timely and accurate medical evaluation information is a challenge in the health care industry. Companies providing medical assessments in this industry are utilizing technology to meet this challenge and to continuously improve performance and functionality. Physician acceptance is a critical factor for successful medical assessment system implementations. This research in progress paper reports on a recently completed national survey of physicians who provide disability assessments, a subset of medical assessments. Accurate and timely information is of vital importance especially regarding disability claim cases as any delay can increase the time to process a claim significantly. Based on 141 completed surveys (a 52% response rate) of a nationwide physician network this study examined physicians' completion of disability evaluations using a Web-based system. While use of the Internet as a medical "library" has been widely studied, this study considered the next step: providing physicians with an online means to complete and submit disability assessments in real-time. This research devised a social-technical model to explore physicians' acceptance of Web-based work process systems. This social- technical model is based on four main classes: Social-demographics, Perceived Readiness, Work Practice Compatibility, and Physician Attitude. Preliminary results indicate that Perceived Readiness and Work Practice Compatibility affect physicians' behavioral intent to use the Web-based disability assessment systems. For example, the more often the physician uses computer systems, the more willing they are to be early volunteers to use the system - 81.9% of the physicians use computer systems frequently, at least several times a week. Additionally, physicians who dictate the medical assessment report using a transcription service will not likely be early volunteers to use the system. These findings will be used to devise recommendations for targeting early online adopters among physician networks.

Keywords: Medical informatics, technology acceptance, end-user acceptance, web-based systems, physician acceptance

Introduction

In the health care industry, companies are being challenged to provide timely and accurate medical information for various parties. The numbers of companies that are providing independent medical evaluations in this industry is increasing and they are forming a large subgroup within the health care industry (Tulu, et al., 2003). To meet this industry challenge, they are utilizing technology to continuously improve performance and functionality. Physician technology acceptance is a critical factor for successful medical assessment system implementations. This research in progress paper reports on a recently completed national survey

of one company's physician network that provides disability assessments, a subset of medical assessments. Accurate and timely information is of vital importance especially regarding disability claim cases as any delay can increase the time to process a claim significantly. To provide accurate and timely information, the company developed a Web-based medical assessment technology. Physicians were asked to fill-in the disability assessment form during the examination through a secure web site and submit this form upon completion of the examination. While the use of the Internet as a medical "library" has been widely studied, this study considered the next step: providing physicians with an online means to complete and submit disability assessments in real-time. This study also provides information regarding the integration of information systems with the work process of physicians. The objective of the study was to examine user acceptance of a new online disability assessment tool and to provide strategies to assist the company in their full implementation of the new online system. The paper first examines and extends existing technology acceptance models, next it describes the proposed research model and hypotheses, third it explains the research methodology, and concludes by discussing the theoretical and practical implications of the preliminary results.

Technology Acceptance Models

A number of technology acceptance models such as Roger's diffusion of innovations model, Kwon and Zmud's diffusion/implementation model, and Davis's Technology Acceptance Model (TAM) have been developed (Kwon and Chidambaram, 2000). Among these, TAM is considered to be the most influential and well researched. The TAM has received close attention by a number of Information Science researchers and practitioners over the last twenty years. It has been used as tool in determining critical success factors regarding the adoption of new Information Systems by organizations and individuals. The TAM has shown that technology acceptance can be adequately explained and accurately predicted through behavioral intention. Factors that reflect behavioral intention include characteristics of the individual, technology, and organization.

The theoretical base for TAM was Fishbein and Ajzen's theory of Reasoned Actions (TRA) introduced in 1975 (Chau and Hu, 2001; Kwon and Chidambaram, 2000). According to TRA, in general, individual beliefs influence a person's attitudes toward the subject, which in turn determines intentions that then trigger desired behavior. Figure 1 illustrates the TRA Model.

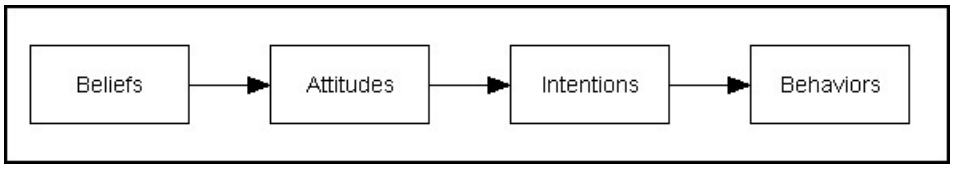

Figure 1. TRA Model

Building on the "Beliefs – Attitudes – Intentions – Behaviors" TRA model approach, (Davis, 1989) developed the Technology Acceptance Model (TAM) to explain technology acceptance (Figure 2). The original TAM is based on the notion that users' attitude towards new technologies are shaped by two related factors: Perceived Usefulness (PU), and Perceived Ease of Use (PEOU). It was also shown that PU (the degree to which a person believes that using a particular system would enhance their job performance) has influence on users' PEOU (the degree to which a person believes that using a particular system would be free of effort), while PEOU also directly affects users' Intentions.

This model was tested in various organizational environments and was shown to be a very reliable predictor of users' actual actions, especially among university students and business executives (Chau and Hu, 2001; Kwon and Chidambaram, 2000). It was shown that PU plays a more significant role in determining Behavioral Intentions than PEOU. This is due to the fact that the importance of PEOU as a determinant to use new technology becomes significant only after a users prolonged exposure to the technology. This fact, while true for the aforementioned group, is not necessarily true for other groups whose daily activities do not expose them to the use of computing technologies to the same degree.

One study (Hu, et al., 1999) investigated TAM applications in the context of individual professionals, such as physicians and attorneys. They tested a number of variations of the TAM model, including the Theory of Planned Behavior (TPB) model, presented in Figure 3. TPB extends TAM by incorporating additional external factors that may influence an end-users' decision to use the technology. It suggests that physicians' intention to use a particular technology is defined by: (1) His or her positive or negative attitude toward the technology, (2) perception of relevant others concerning the use of technology and, (3) perceived

availability of resources and skills/conditions necessary to use the technology. This new model attempted to overcome some of the shortcomings of the traditional TAM model by considering such external aspects as when the individual lacks control over the targeted behavior.

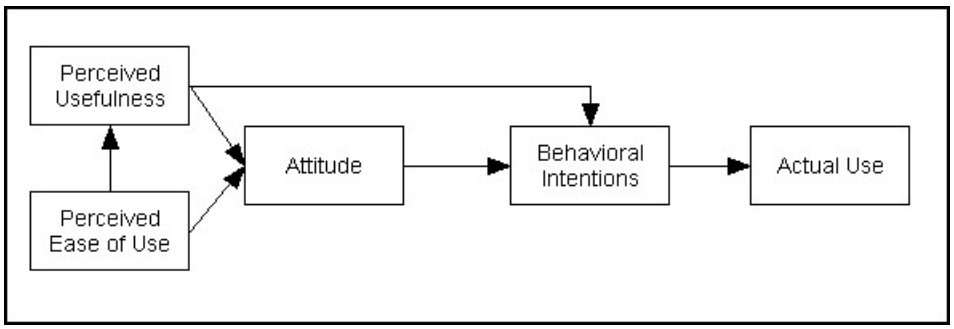

Figure 2. TAM Model

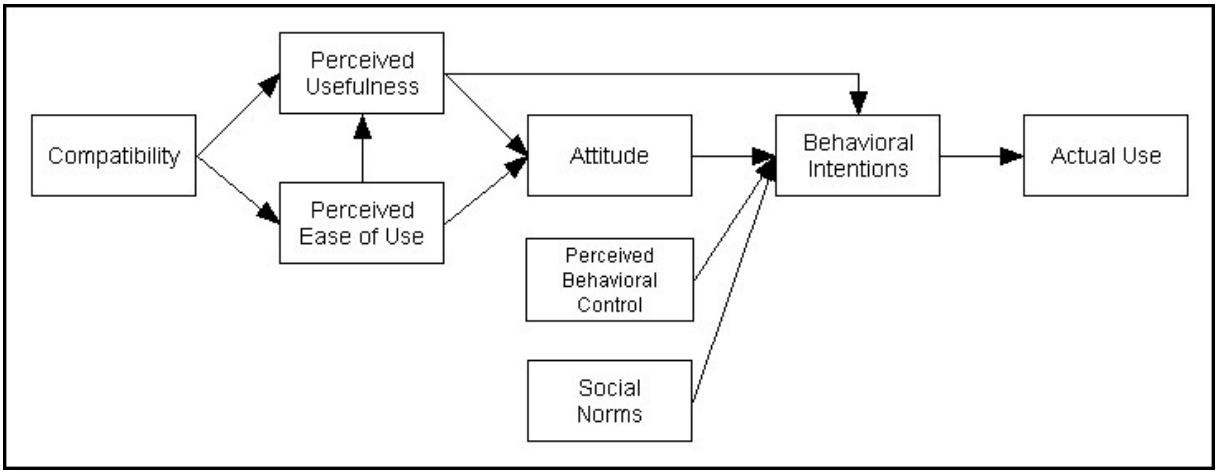

Figure 3. TPB Model

Chau and Hu (2001) also introduced an important new construct, compatibility. Compatibility refers to the degree to which the use of the new technology is perceived by a physician to be consistent with their work practices. It is used to investigate the influence of organizational factors on technology acceptance. By introducing compatibility, Chau and Hu (2001) argued that physicians would be more likely to consider the technology useful if it is perceived to be compatible with their work practices. At the same time, physicians would consider the technology easy to use if they did not need to change their practices significantly. Thus, compatibility favorably affects a provider's attitude toward accepting new applications. Chau and Hu (2001) found that the TPB model represented the best fit with data in acceptance of telemedicine by physicians. Subsequently, the TPB model was used as a basis for this research.

Research Model and Hypothesis

The rapid growth of innovative technology applications that target highly specialized individual professionals, such as physicians, has brought great potential for improving the professionals' performance. However, performance gains are often hindered by the users' unwillingness to accept and use new technologies. To predict the providers' acceptance of the company's new online system, research was conducted based on the prior theoretical methodologies described above. The model developed for this study, shown in Figure 4, has incorporated several aspects of the TPB and the TAM. Furthermore, the structural model (Figure

4) depicts the hypothesized relationships among the various independent and dependent variables. The research model in Figure 4 is an extended version of TAM. The hypotheses of this study are:

Hypothesis 1: Social-Demographics have a direct effect on Behavioral Intention.

Hypothesis 2: Perceived Readiness has a direct effect on Behavioral Intention
- **Hypothesis 2.1:** Organizational Readiness has a direct effect on Perceived Readiness and an indirect effect on Behavioral Intention.
- **Hypothesis 2.2:** Technical Readiness has a direct effect on Perceived Readiness and an indirect effect on Behavioral Intention.

Hypothesis 3: Perceived Usefulness has a direct effect on Behavioral Intention.

Hypothesis 4: Attitude has a direct effect on Behavioral Intention.
- **Hypothesis 4.1:** Perceived Usefulness has a direct effect on Attitude and an indirect effect on Behavioral Intention.
- **Hypothesis 4.2:** Perceived Ease of Use has a direct effect on Attitude and an indirect effect on Behavioral Intention.

Hypothesis 5: Work Practice Compatibility has a direct effect on Behavioral Intention.

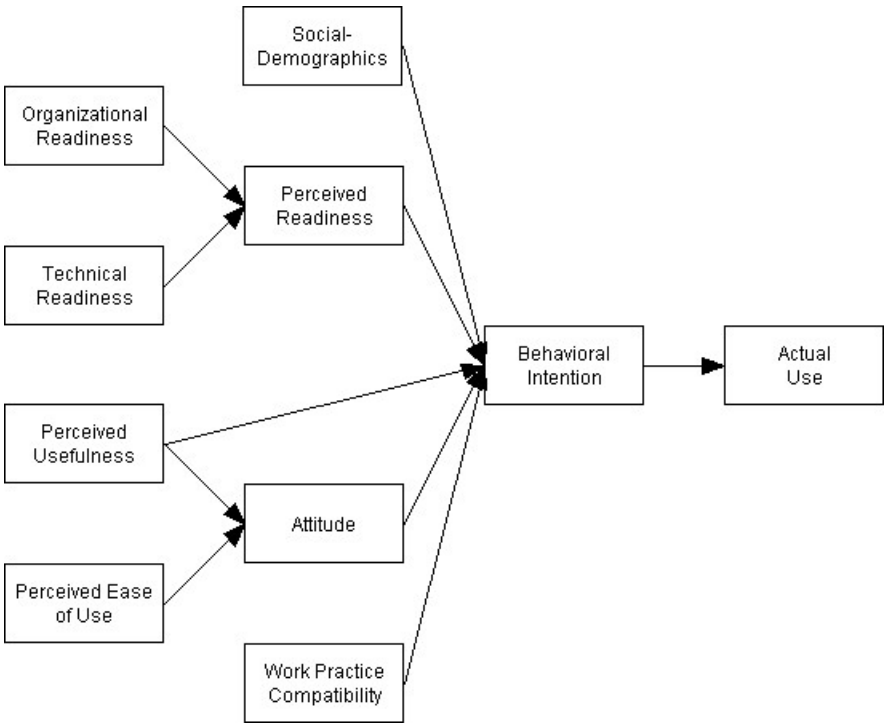

Figure 4. Research Model

Research Methods

Survey and Data Collection

The information system in this study is an Web-based report submission system. The users were provided a short description of the system. This Web-based system is similar in format and style to the original paper-base system; consequently, users were

expected to have an understanding of the Web-based system based on this short description. Data was collected using a questionnaire.

The participant sample was selected from the company's 10,000 providers and was based on the total number of evaluations performed by the providers for the company. The questionnaire was faxed to the 278 providers in the company's provider network that performed 20 or more evaluations either since January 2002 or since they were added to the provider network. It was decided to conduct the survey using fax technology as the company currently utilizes this technology for daily communication with its providers. To facilitate the delivery of the faxes, an Internet fax system rather than a traditional fax machine was used to deliver the questionnaires. From the participant sample of 278, 144 questionnaires were returned, generating a 52% response rate. After the deletion of invalid questionnaires, 141 completed questionnaires were utilized in this study. Several steps were taken to ensure data quality.

A set of prospective survey questions was developed to measure the research model. The questions were selected for their theoretical importance as well as their potential relevance to practice. Through a series of meetings with the company, 36 questions were chosen to be included in the final 3-page questionnaire. The company stipulated the 3-page limit; as a result, some of the constructs in the research model only have two measures.

Instrument Used for Data Collection

The questionnaire used during data collection contained various scales to measure the constructs included in the research model. The constructs were measured with a variety of check-off, fill-in, and scaled-response items. For the constructs Work Process Compatibility and Social-Demographic Factors, open-ended or multiple-choice questions were used. Questions involving other constructs were measured using a 5-point Likert-scale with anchors at strongly agree and strongly disagree or, at extremely important and not important.

Organizational Readiness refers to the degree to which an organization is ready to become involved in using a particular system. Technical Readiness refers to the degree to which a user has the skills and resources to operate a particular system. Perceived Readiness refers to the degree to which a person believes that they are ready to use a particular system. Social-Demographic Factors refers to independent factors such as age, gender, location, and provider's specialty. These four constructs are new and have been introduced due to the requirements of the study.

Perceived Usefulness refers to the degree to which a person believes that using a particular system would enhance their job performance (Davis, 1989). Perceived Ease of Use refers to the degree to which a person believes that using a particular system would be free of effort (Davis, 1989). Attitude refers to the users' evaluation of the desirability of their using the system (Davis, 1989). Behavioral Intention refers to the individual's intention to use the system (Davis, 1989).

These three are measured through scales used in previous studies on TAM. Work Practice Compatibility refers to the degree to which extant systems and practices are consistent with new use of web technology by a physician (Chau and Hu, 2001) and measures were taken from prior research.

Results

Bivariate Analysis

Preliminary bivariate analysis of the data is based on correlations, which are presented in Figure 6. At the bivariate level several of the hypotheses are supported as shown in Figures 5 and 6. In brief, social-demographics do not have any significant effect on the use of the new system. However, it is observed that age has an effect on work practice. Moreover, current work practices are a good predictor of future use of the new system. Perceived readiness is observed to be a good predictor of future use of the new system. Although you would expect the TAM variables to be a good predictor of new system use, the results to predict the frequency of use were insignificant. Attitude especially produced contradictory results. For example, physicians who said they would use the new system also said that they would not be early volunteers and would find the actual experience of using the system difficult.

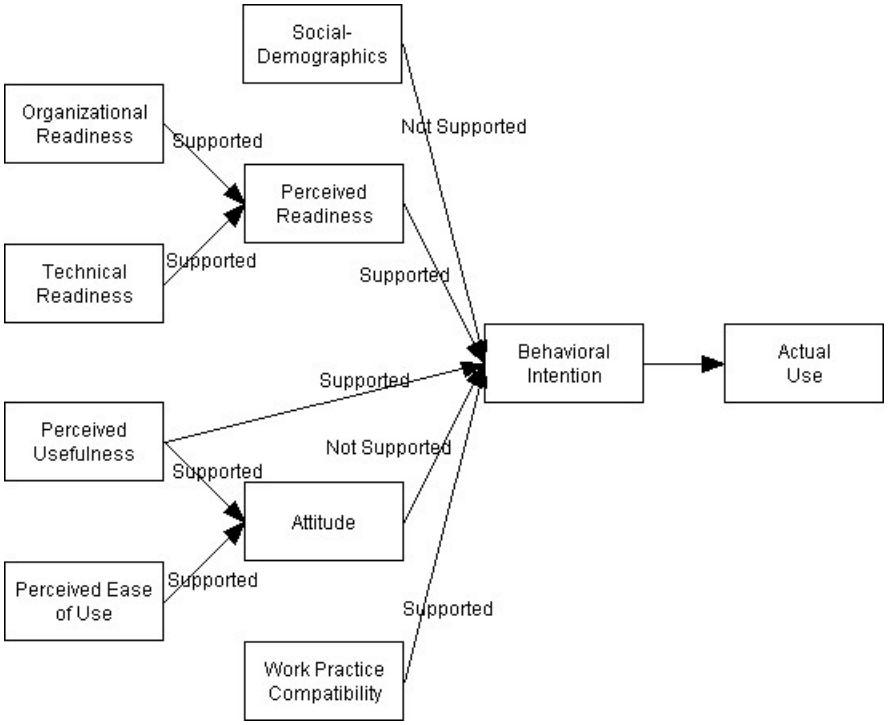

Figure 5. Results of Research Model

Next Step: Multivariate Analysis

Given these strong bivariate relationships, the next step is to analyze the results using several multivariate approaches—both aggregate and disaggregate – this includes Factor Analysis, Stepwise Regression, Structural Equation Modeling (SEM), and Discriminant Analysis. Preliminary Factor Analysis showed that (1) the variables of the Research Model loaded as one factor, (2) the variables of the TAM models loaded as three factors, which accounted for 66% of the total variance inherent in the data collection and, (3) the decomposed research constructs loaded as one factor. In terms of aggregate analysis, steps will be taken to analyze a SEM based on the Research Model. This second phase will complete this SEM analysis as well as the other predictive approaches (e.g. stepwise regression). Moving to a more disaggregated level, descriminant techniques that will explore which of the several factors in the Research Model best discriminates those who expressed behavioral intent to use the system, versus those who did not.

Conclusion

Medical informatics continues to grow as an important source of productivity improvements in the medical arena. Yet, physician acceptance remains a common barrier to new clinical informatics systems (Patel and Kaufman, 1998). This research has helped to establish a context-based approach to understanding factors that could influence physicians' behavioral intent, as well as ultimate behavior. Such factors include the setting in which the physician works, the type of work practice in which they are engaged, as well as perceptions about the value of specific informatics systems. While the next step of analysis (multivariate) will assist in understanding the value of the integrated research model, the practical value at this point seems clear: technology adoption efforts need to attend to several factors surrounding the physician work behavior, not just the general attitude that the physician has about informatics systems. This includes possible efforts to better equip medical settings, to introduce intermediate computer-related work systems, and to stress potential benefits of specific systems. From a research perspective, the findings support the notion that physician adoption of technology needs to be assessed within the context of the work system environment, including specific linkages between proposed and perceived system benefits. This contextual view suggests that IS system design and adoption models need to combine subjective (perception) and objective (work system) factors into a holistic perspective of technology use.

	Physician personally enters data during the evaluation	Physician personally enters data after the evaluation	Physician will use staff to enter data after the evaluation	Physician will not use the system	How often you will use the system?	Comments
Social Demographics - Age		-.223*				***H1 is not supported.***
Organizational Readiness –						***H2.1 is supported .*** The physicians who score high in organizational readiness are more willing to use the new system.
Size of Staff	.251**					
Access to the Internet		.206*		-.221*		
DE for VA		.194*	-.184*			
DE for Private Insurance Companies					-.190*	
Frequency of computer use		.344**		-.436**	.319*	
Technical Readiness –						***H2.2 is supported.*** The physicians who score low in technical readiness will not use the new system. Use of office applications predicts the use of new system.
High Speed Connection	.242**					
Don't know connection speed				.324**		
Don't have access		-.187*		.221*		
Use office applications	.197*	.188*		-.228**	.316**	
Use Email system		.182*		-.210*		
Use Internet Browser		.192*		-.219*		
Use Business Related Systems					.182*	
Perceived Readiness –						***H2 is supported.*** Perceived readiness is a good predictor of use.
We would have enough resources	.291**	.258**		-.366**	.212*	
Additional computer purchase is needed	.182*	.207*			.182*	
Perceived Usefulness –						***H3 is supported.*** ***H4.1 is supported.*** The physicians who perceives computers as useful are more likely to use the new system.
Computers help to cut cost	.230**			-.227**		
Computers make my job easier				-.207*		
Preparing for the exam is easier	.286**			-.366**		
Conducting exam is easier	.288**		.172*	-.394**		
Report generation is easier	.256**	.397**		-.494**		
Report review is easier	.237**	.209*		-.373**		
Report submission is secure	.274**	.263**		-.461**		
Additional feature are useful	.179*	.326**		-.411**		
Perceived Ease of Use –						***H2.1 is supported.*** Physicians using computers would use the new system.
I find it easy to learn new software		.222*		-.291**		
Finding info on the Internet takes time	.218*	.311**	-.270**	-.218*		
Attitude –						***H4 is not supported.*** The results are contradictory.
Best practice should use computers		.191*		-.262**		
I would not volunteer to be an early user	.304**	.217*		-.332*		
New system is a good idea	.267**	.242**		-.346**		
Actual experience of using new system will be difficult	.182*	.187*		-.268**		
Using system is beneficial for my practice	.266**	.285**		-.424**		
Work Practice Compatibility -						***H5 is supported.*** Current work practices is a good predictor of the future use of the new system.
Physician use transcription service		-.201*				
Physician types own report		.285*	-.397**			
Physician use staff to type report		-.342**	.498**			

** : Correlation is significant at the 0.01 level (2-tailed)
* : Correlation is significant at the 0.05 level (2-tailed)

Figure 6. Results of Correlations

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