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Human Factors Affecting HMS Impact on Nurses Jobs:
HMS Impact in Nursing

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ABSTRACT

To improve and facilitate patient care, hospital administrators have implemented healthcare management systems (HMS). Unfortunately, many hospitals have encountered HMS implementation problems. Some user-related factors have been proposed in the literature as important to system success. This study proposes an integrative model and empirically tests the importance of these variables as determinants of HMS impact on the jobs of nurses. Data from 213 nurses using their hospital HMS has been used to test the relationships between the independent variables and the HMS impact on the nurses' jobs. The results confirm the importance of nurse participation, training, good communication with developers, and lack of conflict regarding system implementation enabling a more desirable effect of HMS on nurses' jobs. Based on the results, recommendations are made for hospital administrators to improve the likelihood of HMS implementation success.

KEYWORDS

Healthcare Management Systems (HMS), HMS Impact On Nursing, HMS Implementation, Hospital Innovation

INTRODUCTION

Healthcare information technology in general has been considered as an important factor to reduce costs and improve the efficiency and safety of the health care sector (Fujino & Kawamoto, 2013; McBride, Delaney & Tietze, 2012). Specifically, Healthcare Management Systems (HMS) provide support to many clinical and administrative activities/tasks in a wide variety of hospital areas such as radiology, anesthesia, pathology, emergency medicine, billing services, appointment scheduling, refunds, etc. Within each of these areas the HMS may also be used to support a wide variety of tasks. For example, in radiology alone it may be used for electronic downloads of patient demographic data and to download radiology reports into HMS billing software, on-line coding of transcribed radiology reports, claim submission, posting of remittance notifications, etc. While some hospitals develop some HMS components in-house, most acquire integrated collections of various HMS software/service components commercially available from many vendors. Therefore, in a given hospital the comprehensiveness of the HMS support can vary widely and so can the difficulty of implementing such systems if managers are not careful about the potential implementation problems (Glaser, 2011; Yamazaki, Ikeda, & Umemoto, 2011). Despite continuous efforts to improve hospital productivity and service quality by using information technology (IT), many system implementation problems remain (Bolan, 2011; Glaser, 2011). Perhaps because of HMS's integrative nature, they tend to be relatively large, expensive systems, normally dictated from above. These characteristics often lead to

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unwanted and poorly managed changes. As hospitals' dependence on information systems increases, so does the need to ensure that they perform according to specifications and/or user needs and wants. Primarily for this reason we targeted HMS in this study.

While the reasons for system failure or less than successful system implementation are many, given the increasing hospital IT expenditures, improving system success is of critical importance (Grenuk, 2011). One issue becomes how to measure system success. The more widely used ways are an extent of system usage, user satisfaction with the system, and benefits derived from using the system, the amount or frequency of system usage, and the impact that specific systems have on end-user jobs. Which one represents the best measure of success depends on the objective of the study. According to the literature, there is an urgent need for understanding the issue of nurse retention and turnover (Currie & Hill, 2012; Nei, Snyder, & Litwiller, 2014); and also why nurses have been relatively slow embracing the use of computer technology while performing their jobs (Cross & MacDonald, 2013). Thus, similar to the motivation of previous studies regarding information systems impact on end-user jobs (Yoon & Guimaraes, 1995; Yoon, Guimaraes, & Clevenson, 1996), we chose it as the dependent variable. If hospital administrators can improve organization performance along the HMS development and implementation user factors leading to more positive impact on nurses' jobs, that are likely to help improve nurses' adoption of computer technology in general, and hopefully help improve the problems of nurse retention and turnover mentioned above. Thus, we selected nurses as the subjects for this study.

The importance of user satisfaction with and the job impact from their information systems is widely recognized and cannot be overestimated given the enormous amount of hospital resources spent in this area, and the degree of dependence on the increasing collection of system applications (Hart, 2011; Metaxiotis, 2006). However, there remain some important questions, which this research tries to address: Will nurses' job impact be affected by some of the same variables found important to general system success? How important are some human related factors such as nurse training and participation in system implementation, as well as other user characteristics as determinants of job impact from HMS implementation and use. The importance of user participation in systems implementation as an important ingredient for system success in general has been studied before (Hwang & Thorn, 1999; Mahmood, Burn, Gemoets, & Jacquez, 2000; Metaxiotis, 2006; Subramanyan, Weisstein, & Krishnan, 2010). One may expect that finding evidence to corroborate the essential role that users play during system development/implementation should be a simple matter. Surprisingly, this is not the case. While the majority of research evidence finds user participation/involvement correlated with various measures of system success (Hwang and Thorn, 1999; Mahmood et al., 2000; Subramanyan et al., 2010), the literature has often presented conflicting results. Some studies have shown user participation to be positively correlated with system success, negatively correlated with system success, and sometimes non-significantly correlated with system success (Brodbeck, 2001; Chen, Yu-Chih Liu, & Chen, 2011). As mentioned above other user characteristics beyond mere participation in the system development process have been found to be important factors by various authors.

Depending on hospital administration hiring, training, and cultivating these factors, which are believed to be important determinants of nurse satisfaction with their HMS, their behavior toward HMS, may range widely from avoidance, to reluctant usage, to using it often as a productive tool. To complicate matters, as discussed earlier, because HMS is expected to provide operational support for many vital hospital services, in many cases its usage is required regardless of any particular group's satisfaction with the system. The main objective of this study is to test the relationships between the human related factors mentioned above with a favorable HMS impact on the nurses' jobs. In the next section, we define the primary constructs studied here (HMS job impact, user participation, user expertise, user/developer communication, user training, user influence, and user conflict). We explain the nature of each variable and respectively propose testable hypotheses. Following that, we explain the methodology used and present the results of our tests. Finally, we discuss the implications of the results for managers and researchers.

THE THEORETICAL BACKGROUND AND HYPOTHESES TESTED

The dependent variable (HMS user job impact) and its proposed determinants comprise the research model empirically tested in this study. This model is graphically shown in Figure 1.

The Dependent Variable

HMS Job Impact

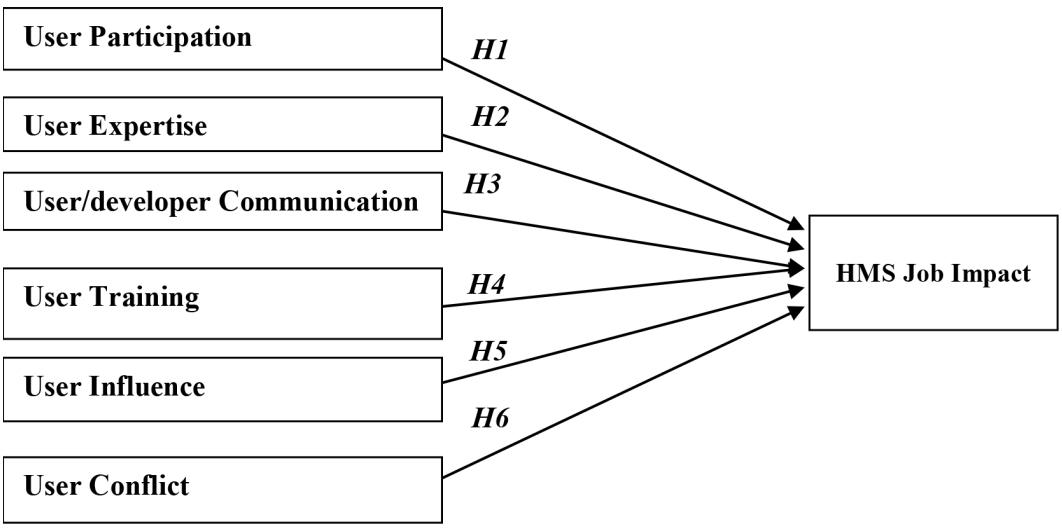
In the study of systems impact on end-user's jobs, DeLone and McLean (1992) presented two factors affecting the impact on individual jobs: end-user satisfaction and usage. Several different measures for the impact of computer-based systems on end-users' jobs have been previously reported on. Benbasat and Dexter (1979) used the average time to make a decision. Chervany and Dickson (1974) measured the confidence in the decision made. Byrd (1992) assessed impact based on fear of loss of control and fear of loss of jobs. Sviokla (1990) measured the impact of XCON (a strategic expert system) on end-user jobs by examining the changes on input and output, the increase in the task accuracy and the amount of work completed, the shifts in the end-user role and responsibilities, and job satisfaction. The general impact of information and communications technology on nurses' jobs has been studied by Fujino and Kawamoto (2013), McBride et al. (2012), and Cross and MacDonald (2013). Most prior studies have used one or two items to measure system impact on end-user jobs. Similar to previous studies (Yoon and Guimaraes, 1995; Yoon et al., 1996), we have employed eleven variables to measure the HMS impact on the respondent's job to address the perceived change in the importance of the end-users' job, amount of work required on the job, accuracy demanded on the job, skills needed to do the job, job appeal, feedback on job performance, freedom in how to do the job, opportunity for advancement, job security, relationship with fellow employees, and job satisfaction. The specific items included in the measures for this and the other constructs in this study are presented later in the variable measurement section and are listed in Appendix A.

The Independent Variables

User participation

This refers to the extent to which non-IS members of an organization are engaged in activities related to systems development (Metaxiotis, 2006; Robey et al., 1989; Subramanyan et al., 2010). According

Figure 1. The research model



to Barki and Hartwick (1994a), participation can therefore be measured by "assessing the specific assignments, activities, and behaviors that users or their representatives perform during the systems development process." Using meta-analytical techniques, Hwang and Thorn (1999) reviewed the IS literature and concluded that user participation has a positive correlation with system success as measured by usage and user satisfaction. Based on this discussion we propose H1: User participation is positively related to HMS job impact.

User Expertise

Similar to the self-efficacy construct which reflects confidence in one's ability to exert control over one's own motivation, behavior, and social environment as well as one's capacity to execute behaviors necessary to produce specific performance attainments (Bandura, 1997), user expertise is much narrower in scope and represents a user's acquired experience and skill level with regard to system usage and development (Igbaria, Guimaraes, & Davis, 1995). Not all users are equal in their ability to participate meaningfully within the system implementation process. It seems intuitive that their level of expertise in the development of systems would be important. User expertise is gained through both experience on previous development efforts and through training in preparation for the tasks that they are required to perform. Experienced users are expected to perform to higher standards given their facility with the "tools of the trade" (e.g., methodologies, notation, processes, language, tools, acronyms, documents, deliverables, and pro-forma analysis). We expect this facility (i.e., expertise) to have a positive effect on the nature of their participation, its impact on system success, as well as the formation of beliefs. That is, user expertise will have an impact on the behavioral aspect as well as the psychological aspect of system implementation. Users with high expertise are able to participate more efficiently and effectively during the implementation process and, through this participation, are able to form more accurate expectations about the functioning of the resultant system (and its impact on their working lives) than users with less expertise (Lemmetty, Häyrinen, & Sundgren, 2008; Discenza, Tesch, Klein, & Jiang, 2008). For these reasons, we expect that the relationship between user participation and system success will be stronger when user expertise is higher.

Previous research has established how user expertise raises expectations and performance levels within the systems implementation process. Saleem (1996) found that "users who perceive themselves as functional experts are unlikely to accept a system unless they exerted a substantive influence on its design". This result was found to hold in both experimental and field research. It is based on the belief that the participation of expert users in system design should result in a better-quality system through integration of employee expertise, better understanding of users' information requirements, superior evaluation of the system, and more accurate formation of expectations regarding the new system and its impact on the organization. Thus, we propose H2: User expertise is positively related to HMS job impact.

User-Developer Communication

User-developer communication indicates the quality of the communications that exists between the systems designers and the user participants (Monge, Buckman, Dillard, & Eisenberg, 1983; Guinan, 1988). Communication plays a key facilitating role within the process of application system development (Limpornpugdee, Janz, & Richardson, 2009; Gallivan and Keil, 2003). According to McKeen et al. (1994), "what facilitates productive, collaborative effort in the conduct of systems development is effective communication … due to the necessity of users to convey their understanding and insight of business practice accurately and completely to developers who, in turn, must receive this information and translate it into a working computer system. Accordingly, effective communication works to the benefit of both parties".

It is through articulation, conveyance, reception and feedback that user/system requirements gain currency and have effect. Communication, to be effective, must flow both ways – from sender to receiver and vice versa. With effective user-developer communication, participation will be

more meaningful. Users' input will be heard and understood by developers and users will be able to understand technical tradeoffs as described by developers. As a result, effective communication will provide clarity. Beliefs will be based on a more comprehensive understanding of the system deliverables and the system itself will be implemented as articulated. In situations where effective communication is lacking, the benefit of user participation is lessened – users fail to convey their needs for (and understanding of) the system under development accurately and developers fail to seek, explain, and translate user needs into system requirements effectively. As a result, ineffective communication weakens the relationship between user participation and system success. Conversely, we argue that the relationship between user participation and system success is stronger where user-developer communication is of high quality. Empirical research bears this out. In a study of 151 application systems, McKeen et al. (1994) found that user-developer communication moderated the relationship between user participation and user satisfaction as well as having a direct impact on user satisfaction. They found that, in situations where there was effective user-developer communication, the relationship between user participation and user satisfaction was stronger than in situations where communication was less effective.

The quality of communication has a psychological impact on systems development as well. With ineffective communication, users convey/form ideas, impressions and expectations of the end system based on incomplete (or inaccurate) information due to misunderstandings between themselves and the design team. Although we are not able to cite empirical evidence to support this assertion, we expect that the relationship between user participation and user involvement will be stronger where there is effective communication and weaker where there is not. In sum, we propose H3: User-developer communication is directly related to HMS job impact.

User Training

The importance of user training for system success has been recognized widely (Igbaria et al., 1995; Lemmetty et al., 2008; Santhanam, Guimaraes, & George, 2000; Yoon, Guimaraes & O'Neal, 1995). Training is important to provide a general background to familiarize users with the general use of computer technology, the process of systems development, and to help users to effectively use the specific system under development. Based on that we propose H4: User training is positively related to HMS job impact.

User Influence

Robey et al. (1989) defined user influence as the extent to which members of an organization affect decisions related to the final design of an information system. Furthermore, they argue that it is through participation that users exercise this influence. McKeen et al. (1994) concur and claim, "without participation, there can be no influence." Saleem (1996) outlines the role of user influence within system development by differentiating it from user participation as follows: "Participation varies in degree, that is, in the extent of user influence on the system design … this variation may be conceived as a continuum. On the low end of this continuum, user input is not solicited or is ignored; and, on the high end, user input forms the basis of system requirements … Thus, participation and influence are not synonymous; a participant user may or may not have any influence on the system development."

With high levels of influence, users become active decision makers within the system development process. Through the exercise of their responsibilities, these instrumental players are able to shape the resultant system to function in ways that best advances their vision of automation. As compared to users with low levels of influence, these users participate (i.e., the behavioral dimension) much more effectively and form beliefs about the system (i.e., the psychological aspect) with greater acumen based solely on their ability to affect the end product of development. Thus, we expect the relationship between user participation and user satisfaction (the behavioral impact) to be stronger where user influence is high and weaker where it is not.

Empirical research has demonstrated the importance of user influence in systems development (Chen et al., 2011; Hsu, Chen, Jiang, & Klein, 2010). Hunton and Beeler (1997) found that participation by mandatory users was significantly related to user performance leading them to conclude, "participation by mandatory users may be ineffective, particularly if the users do not gain a sense of overall responsibility (i.e., control)." Barki and Hartwick (1994b) identified three components of user participation – overall responsibility, user-IS relationship, and hands-on activity – but found that overall responsibility was the key dimension of user participation. Interestingly, overall responsibility (which refers to user activities and assignments reflecting overall leadership or accountability for the system development project) is closely related to the concept of user influence.

Doll and Torkzadeh (1989) argued the importance of user influence due to the likelihood that "without adequate influence to change things and affect results, users are likely to see their participation as a waste of time or, worse still, as an act of social manipulation". By differentiating user participation and user influence, it is possible to understand how user participation is most useful when balanced appropriately with user influence. Such a balance gives rise to "meaningful" participation (Barki & Hartwick, 1994b). Imbalanced situations (that is, high participation accompanied by low influence or low participation accompanied by high influence) would result in "hollow" participation (in the first instance) and "coercive" participation (in the second instance). According to Saleem (1996), users caught in the "hollow" participation role may feel manipulated while those in the "coercive" participation role would exert undue influence over the system development without participating fully.

Closely related to influence/control and the preceding argument is the concept of "voice." Hunton and Price (1997) differentiate participation by voice (the probabilistic control over the decision-making process) from participation by choice (the deterministic control because the degree to which choice impacts the decision outcome is known in advance). In another work, Hunton and Beeler (1997) articulate instrumental voice as the opportunity for users to express their opinions, preferences, and concerns to decision makers thus providing users with a sense of control during the development process since the expression of instrumental voice is expected to become manifest in the decision outcome. The exercise of voice engenders feelings of ownership, relevance and importance on the part of users. For all these reasons, we propose H5: User influence is positively related to HMS job impact.

User Conflict

As pointed out by Hartwick and Barki (1994), multiple definitions of conflict exist (Hocker & Wilmot, 1985; Putnam & Wilson, 1982), and the various definitions reveal three key facets: conflict occurs among interacting parties; there is divergence of interests, opinions, or goals among these parties; and these differences appear incompatible to the parties. Such conditions occur frequently during systems development (Pollock, 2005; Smith & McKeen, 1992). In every case, conflict between users and system developers is expected to produce negative results during the system development process. Ultimately, such conflict may impair communication during the development process, discourage user participation, and lead to dysfunctional behavior. For these reasons we propose H6: User conflict is negatively related to HMS job impact.

A quantitative research design was chosen to examine the proposed relationships among the various constructs in the research model. The next section describes the data collection process, characteristics of the sample, measures used, and the data analysis methods employed to test the research model.

METHODOLOGY

Sampling and Data Collection

A data collection packet was sent to the CEO of 400 hospitals in the USA, randomly selected from a national directory of health care organizations. The packet contained a cover letter explaining the purpose of the study, asking for participation only if the hospital had an HMS fully operational for at least six months, and offering to share the results from this study. Also included in the packet was

an already published research report from a prior study on hospital BPR project implementation success. The CEO's were asked to answer a few questions about the hospital and its' IS department, and asked to distribute researchers' pre-stamped, directly returnable to the researchers (self-addressed) questionnaires to 5 to10 nurses who are frequent users of the HMS system. Many participating hospitals returned one questionnaire representing the nursing group rather than individuals. A total of 418 questionnaires from 122 hospitals were returned but 19 were discarded for incomplete data, producing a usable sample size of 399. For this study, the nurses were asked to address the questions regarding the independent variables and their level of satisfaction with the HMS presently operational at the hospital.

Sample Description

The sample demographics for the hospitals and participants in this field test are presented (see Table 1). The sample shows good representation based on hospital geographical area, number of beds (size), and self-rated IT sophistication.

Construct Measurement

The measures used have been adopted from several different sources. To facilitate future, inter study comparisons the items used in each measure and the related scales have not been changed, thus some measures use a 5-point or a 7-point scale. This variation is not considered a problem for this study's data analyses. Details on how each construct was operationalized in this study are provided below. Appendix A contains a list of the specific questions used to measure each construct relevant to this report.

HMS Job Impact

It was measured by perceived impacts since more objective job impact measures were unavailable in this field context, and also because such measures would not have been compatible across individuals with different task portfolios, thus jeopardizing the validity of the measure. Similar to previous studies (Yoon & Guimaraes, 1995; Yoon et al., 1996), eleven questions, adapted from Millman and Hartwick (1987), were used and they asked respondents to self-report on the perceived impact of HMS regarding their performance, productivity, and effectiveness in their job. Seven of these items were originally taken from Hackman and Oldham's research (1980) and dealt with various aspects of an individual's work (importance of the job, amount of work required on the job, accuracy demanded by the job, skills needed to do the job, amount of freedom in how to do the job, job appeal, and feedback on the job performance). Four additional items dealt with other job concerns detailed within the job satisfaction literature (Bikson, Stasz, & Mankin, 1985; Kraut, Dumais, & Kock, 1989), including: their relationship with fellow employees, job security, opportunity in advancement, and job satisfaction. Using the scale (1 = very strong disagreement; 2 = strong disagreement; 3 = mild disagreement; 4 = neutral feelings or don't know; 5 = mild agreement; 6 = strong agreement; 7 = very strong agreement), respondents were asked to please indicate if the HMS has had a positive impact on each aspect of their respective jobs.

User Participation

The measure of end-user participation in the system development process was adapted from Doll and Torkzadeh (1989) and Santhanam et al. (2000). Respondents were asked to what extent they were primary players in each of nine specific activities, such as initiating the project, establishing the objectives for the project, determining the system availability/access, and outlining information flows. The 5-point scale ranged from "1" (not at all) to "5" (great extent). Nurses answered these questions.

User Experience

This measure was adapted from Igbaria et al. (1995). It assessed user computer experience by asking respondents to rate the extent of their experience relative to their peers along five dimensions:

Table 1. Selected hospital demographics

US Geographical Area	Frequency	%
Southwest	29	24%
Southeast	17	14%
Central	22	18%
Northwest	19	16%
Northeast	35	29%
Total	122	100%
Number of beds	**Frequency**	%
50 or below	9	7%
51 to 100	18	15%
101 to 300	39	32%
301 to 500	42	34%
501 or above	14	11%
Total	122	100%
Hospital IT Sophistication	**Frequency**	%
Greatly below average	4	3%
Below average	29	24%
About average	45	37%
Above average	32	26%
Greatly above average	12	10%
Total	122	100%
Length of Time HMS is operational	Frequency	%
Less than 6 months	0	0%
6 to 12 months	16	13%
1 to 3 years	26	21%
3 to 5 years	47	39%
Over 5 years	33	27%
Total	122	
HMS # of Hospital Functional Areas Supported (i.e. radiology, emergency medicine, billing services, appointment scheduling, insurance billing, etc.,	Frequency	%
1 to 2 areas	9	7%
3 to 5 areas	37	30%
6 to 10 areas	42	34%
Over 10 areas	34	28%
Total	122	100%

experience using systems of the type, using the specific system, using computers in general, being a member of a system development team, and as a member of the development team for the specific system being studied. The rating scale ranged from "1" (not at all) to "5" (to a great extent).

User/Developer Communication

The measure was originally developed by Monge, et al. (1983) and modified by Guinan (1988) to assess communication quality. Subsequently it was used by McKeen et al. (1994). Using the scale ranging from 1 = very strong disagreement; 2 = strong disagreement; 3 = mild disagreement; 4 = neutral feelings or don't know; 5 = mild agreement; 6 = strong agreement; 7 = very strong agreement with, users were asked to rate the communication process between themselves and the systems developers along 12 statements regarding whether developers had "a good command of the language," were "good listeners," and "expressed their ideas clearly."

User Training

This measure was proposed by Nelson and Cheney (1987) and has been used extensively (Igbaria et al., 1995; Santhanam et al., 2000; Yoon et al., 1995). Respondents were asked to report the extent of training, which in any way affects their use of the specific system. Five sources: college courses taken, vendor training, in-house training, self-study using tutorials, and self-study using manuals and printed documents were the areas assessed as components of user training. For each source, this was measured with a five-item scale ranging from "1" (not at all) to "5" (to a great extent).

User Influence

Based on the work of Robey and Farrow (1982) and Robey et al. (1989, 1993), Hartwick and Barki (1994) used a measure for user influence composed of three items: How much influence did you have in decisions made about this system during its development? To what extent were your opinions about this system actually considered by others? Overall, how much personal influence did you have on this system? For this study, end users were asked to rate the degree of influence along each item with a scale ranging from "1" (not at all) to "5" (very much).

User Conflict

Based on the work of Robey and Farrow (1982) and Robey et al. (1989 & 1993), this study adopted the measure for user/developer conflict used by Hartwick and Barki (1994). It is composed of three items that asked: Was there much conflict concerning this system between yourself and others? To what extent were you directly involved in disagreements about this system? Was there much debate about the issues concerning this system between yourself and others? For this study, end users were asked to rate the degree of conflict along each of these items using a scale ranging from "1" (not at all) to "5" (very much).

In this study we chose measures that had demonstrated reliability and validity in previous studies. The number of items used to measure each construct along with indicators of reliability and correlations among the constructs, are summarized (see Table 2). As discussed in the results section, psychometric properties of all constructs were acceptable.

Data Analysis

To test the proposed hypotheses, the relationships between the independent variables and the dependent variable are separately assessed through the calculation of Pearson's correlation coefficients. To address the possibility that the independent variables are also interrelated, multivariate regression analysis has been undertaken to produce a model capable of explaining the largest possible variance in the dependent variable.

Table 2. Measurement Characteristics of the Constructs (n= 399)

					Pearson Correlation Coefficients					
Construct/Scale	**Number of Items**	**Cronbach's Alpha**	**Mean**	**Std. Dev.**	**1**	**2**	**3**	**4**	**5**	**6**
1. HMS Job Impact	11	0.86	2.85	1.31						
2. User Participation	9	0.89	2.86	0.85	0.49**					
3. User Experience	5	0.87	2.79	1.16	0.52**	0.34**				
4. User-Developer Communication	12	0.95	3.56	1.21	0.35**	NS	0.24**			
5. User Training	5	0.81	2.82	0.72	0.50**	0.48**	NS	0.14*		
6. User Influence	3	0.77	2.71	1.18	0.49**	NS	NS	0.39**	NS	
7. User Conflict	3	0.78	2.93	1.33	-0.33**	NS	NS	-0.39**	-0.30**	-0.31**

** = p < .01 or lower * = p < .05; NS = Not Significant

RESULTS

The Cronbach's alpha coefficient of internal reliability for each of the constructs in the research model is shown in Table 2. The Cronbach's alpha coefficient should exceed 0.7, thus all the scales in Table 2 should be considered as providing adequate internal reliability. Despite the fact that the psychometric characteristics of the constructs and measures used in this study are widely known, their discriminant validity was assessed once again by conducting exploratory factor analysis with all the items from all the constructs. As expected a clear pattern of factors emerged. Each item loaded unambiguously on the intended factor/construct with the items having acceptably low cross-loadings (i.e. all items did not load higher on any factor other than its target construct). These findings confirm good discriminant validity among the constructs, indicating that the questions used in this study tap into the meaning of the intended construct, while not substantially tapping into the meaning of any of the other constructs. To eliminate the potential effects of multicolinearity among the independent variables, the results from the multivariate regression analysis for the research model are summarized (see Table 3).

Results from Hypothesis Testing

The results presented in Table 2 show that all the proposed hypotheses are accepted at the .01 significance level or better. Table 3 shows that in the order in which they entered the multivariate regression equation, user experience, perceived user influence over the HMS implementation process, user participation in the process, user training, and user/HMS developer communication during the process combined can explain 58 percent of the variance in HMS positive job impact. The negative impact of user/developer conflict during the system development and implementation, while having an inverse statistically significant relationship with HMS job impact, does not significantly add to the explanatory value of the multivariate regression model.

As one would expect, Table 2 also indicates that more experienced and/or more trained users tend to participate more in HMS development/implementation activities and tend to communicate better with systems developers. Further, users reporting to have more influence over the system development/implementation process tend to have better communication with system developers. Users with more training, more influence, and/or reporting better communication with system developers tend to have less conflict during the HMS development/implementation process.

Table 3. Results from Multivariate Regression Dependent Variable: HMS Job Impact (n=399)

Independent Variables:	Incremental R Squared
User Experience	.27**
User Influence	.12**
User Participation	.09**
User Training	.06*
User/developer Communication	.04*
User Conflict	N.S.
Total R-Squared	.58**

** = p<.01 or lower * = p<.05; N.S. = Not Significant

DISCUSSION AND IMPLICATIONS

While HMS technologies have been widely used in hospitals for many decades, the results have been mixed. As hospitals' dependence on HMS increases, so does the need to ensure that they perform according to specifications and/or user needs and wants. While the technologies grow increasingly complex and more sophisticated, the important fact is HMS are developed by people to support and serve people trying to perform their critical hospital jobs. The main objective of this study was to test a set of hypotheses regarding some human factors surrounding HMS development and implementation. Specifically, it looks at user characteristics proposed by various authors as important determinants of HMS success in this case defined as its impact on nurses' jobs. The results show that while HMS job impact on average can be seen as acceptable, there is much room for improvement. The large standard deviations indicate that HMS job impact varies considerably from hospital to hospital, as well as for individual nurses.

The primary reason for choosing nurse job impact from their HMS is that a primary reason for hospital installation of HMS is to reduce hospital operational costs and make the care providers' jobs more efficient. If the HMS impact on the nurses' jobs is not positive, hospital administrators may find HMS implementation hurting productivity, and creating personnel and operational problems with long term implications for hospital performance.

The results strongly corroborate the importance of the nurses' experience with the particular type of system, their perceived influence over the HMS development/implementation process, their participation in the same process, their training, and user communication with the developers/implementers. User participation in the process is particularly critical because without it user/developer communication is not possible and, in turn, it has been found important to reduce user conflict regarding the HMS project.

Previous user experience with computer technology and the system development/implementation process is directly related to system success, user participation, and user/developer communication. Nevertheless, managers have to strike a balance between employing experienced users too often versus providing inexperienced users the opportunity to participate in new system development/implementation projects and to develop their computer technology knowledge and skills useful for future projects. For the more critical projects, managers must ensure that experienced users are available to participate. In cases where user requirements are not clear or are not being clearly met, managers must promote user/developer communication and user conflict resolution to enhance project success.

The importance of user training comes across not only as a determinant of a positive system impact on the nurses' jobs but also as a significant factor for user participation in the HMS development/implementation process, for improving user/developer communication, and to reduce user conflict regarding the project. Needless to say, managers must take more seriously the importance of user

training to improve system success, to improve relations with the user community, and more effectively use company IT resources in the long run.

User/developer communication has a direct relationship to system success as measured here (job impact), and also is a significant factor in reducing user conflict during the system development process and to give users a feeling that they actually can influence the project outcome. On the other hand, users also will be more likely to strive for better communication with system developers if they believe they can influence the development process and get the system they want. As mentioned earlier, for new systems with complex or poorly understood user requirements, it is critical that managers ensure strong user participation, user influence, and user conflict resolution by promoting user/developer communication. For systems with complex user requirements, this may lead to considerable changes to system requirements and design. In such cases managers should consider using a prototyping approach to systems development/implementation that requires flexible tools and methodologies. While in the short run that may increase systems development costs and completion time, it is preferable to trying to implement an HMS that may become useless or a source of organization turmoil.

Study Limitations and Future Research

While the research model, the constructs and measures used in this study have strong theoretical support from the literature, this study can be improved in several ways which represent major opportunities for further research. To maintain a reasonable response, rate the questionnaire used did not include several nurse demographics which may be significant control variables such as age, sex, working experience and longevity at the particular hospital and prior. Similarly, interesting would be the inclusion of constructs and their related measures regarding HMS developer/vendor variables, the management of the development/implementation process, as well as organization characteristics such as management leadership, culture, ability to manage change in general. Further, with higher sample sizes, future research can explore possible mediating and/or moderating interactions among the independent variable through path analysis using Structured Equation Modeling techniques available with software packages like PLS and LISREL. Last, given the wide differences in the nursing profession from country to country due to the level of resources available, the social political systems, health care policy, and cultural traits, future research might benefit from a broader view of the questions addressed in this study.

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APPENDIX A: QUESTIONS USED TO MEASURE THE CONSTRUCTS

HMS Job Impact: On a Scale (1 = very strong disagreement; 2 = strong disagreement; 3 = mild disagreement; 4 = neutral feelings or don't know; 5 = mild agreement; 6 = strong agreement; 7 = very strong agreement) please rate the impact of your HMS on each aspect of your job listed below. The HMS has had a positive impact on the:

Table 4. Job impact

Item Number	Question Wording
Job Impact 1	Importance of the job
Job Impact 2	Amount of work required on the job
Job Impact 3	Accuracy demanded by the job
Job Impact 4	Skills needed to do the job
Job Impact 5	Amount of freedom in how to do the job,
Job Impact 6	Job appeal
Job Impact 7	Feedback on job performance
Job Impact 8	Relationships with fellow employees
Job Impact 9	Job security
Job Impact 10	Opportunity for advancement
Job Impact 11	Overall job satisfaction

User Participation: On the scale: 1 = Not at all; 2 = Minor Extent; 3 = Moderate Extent; 4 = Major Extent; 5 = Great Extent, respondents were asked, "Regarding participation in the development of this system. You and other user(s) were primary players in:"

Table 5. User participation

Item Number	Question Wording
User participation 1	Initiating the project
User participation 2	Establishing the objective of the project
User participation 3	Determining the user's requirements
User participation 4	Assessing ways to meet user's requirements
User participation 5	Identifying the sources of information
User participation 6	Outlining information flows
User participation 7	Developing the input forms/screens
User participation 8	Developing the output forms/screens
User participation 9	Determining the system availability/access

User Experience: Respondents were asked to "Compared to most business people you know, and based on the number of years of experience you have and the intensity of your experience, rate yourself along the following items" using the same scale as above.

Table 6. User experience

Item Number	Question Wording
User experience 1	Experience using systems of this type and nature
User experience 2	Experience using this particular system
User experience 3	Experience using computers in general
User experience 4	Experience as a member of system development teams
User experience 5	Your ability to perform as a team member implementing this system

User-developer Communication: Respondents were asked "Using the scale (1 = very strong disagreement; 2 = strong disagreement; 3 = mild disagreement; 4 = neutral feelings or don't know; 5 = mild agreement; 6 = strong agreement; 7 = very strong agreement), please describe how the system vendor/developer(s) communicated with you during the development of this system. If you dealt with more than one person, concentrate on the one whom you dealt with most of the time during system implementation. Think about his/her behavior in general, rather than about specific situations."

Table 7. User-Dev comm

Item Number	Question Wording
User-Dev comm 1	The system vendor/developer(s) had good command of the language
User-Dev comm 2	The system developer(s) was/were sensitive to others' needs of the moment
User-Dev comm 3	The system vendor/developer(s) typically got right to the point
User-Dev comm 4	The system vendor/developer(s) paid attention to what other people said
User-Dev comm 5	The system vendor/developer(s) dealt with others effectively
User-Dev comm 6	The system vendor/developer(s) was/were good listener(s)
User-Dev comm 7	The system vendor/developer(s) writing was difficult to understand
User-Dev comm 8	The system vendor/developer(s) expressed ideas clearly
User-Dev comm 9	The system vendor/developer(s) speech were difficult to understand
User-Dev comm 10	The system vendor/developer(s) generally said the right thing at the right time
User-Dev comm 11	The system vendor/developer(s) was/were easy to talk to
User-Dev comm 12	The system vendor/developer(s) usually responded to messages (memos, phone calls, reports, etc.) quickly

User Training: On a scale ranging from: 1 = Not at all; 2 = Minor Extent; 3 = Moderate Extent; 4 = Major Extent; 5 = Great Extent, respondents were asked, "Which of the following categories best describes the level of training you have had which in any way affected your use of this system."

Table 8. User training

Item Number	Question Wording
User training 1	General courses at a community college or university
User training 2	Training provided by vendors or outside consultants
User training 3	In house company courses
User training 4	Through self- study using tutorials
User training 5	Through self- study using manuals & printed documents

User Influence: Using the same scale as above, respondents were asked to "rate the degree of influence you had in this HMS implementation process."

Table 9. User influence

Item Number	Question Wording
User Influence 1	How much influence did you have in decisions made about this system during development?
User Influence 2	To what extent were your opinions about this system actually considered by others?
User Influence 3	Overall, how much personal influence did you have on this system?

User Conflict: Using the same scale as above, respondents were asked to "rate the degree of conflict surrounding this HMS implementation process."

Table 10. User conflict

Item Number	Question Wording
User conflict 1	Was there much conflict between yourself and others concerning this system?
User conflict 2	To what extent were you directly involved in disagreements about this system?
User conflict 3	Was there much debate between yourself and others over issues concerning this system?