2008

Direct and Indirect Use of Information Systems in Organizations: An Empirical Investigation of System Usage in a Public Hospital

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DIRECT AND INDIRECT USE OF INFORMATION SYSTEMS IN ORGANIZATIONS: AN EMPIRICAL INVESTIGATION OF SYSTEM USAGE IN A PUBLIC HOSPITAL

L'utilisation directe et indirecte des systèmes d'information dans les organisations : une investigation empirique de l'usage d'un système dans un hôpital public

Completed Research Paper

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Abstract

A user's interaction with an Information System (IS) could transpire in two ways: direct and indirect. While most prior literature examines the direct interaction between a user and the system, few have examined and differentiated between direct and indirect use. In this study, we anchor on the theory of psychological attachment to study the effects of various external social factors on direct-usage and indirect-usage of an organizational IS. Survey results from 102 physicians in a public hospital reveal that punishment and informational influence are significantly related to direct-usage of the Electronic Medical Record System (EMRS) by physicians. Punishment and image are significantly associated with indirect-usage of EMRS.

Keywords: Healthcare, direct / indirect system usage, social influence

Résumé

Dans cette étude, nous mobilisons la théorie de l'attachement psychologique pour étudier les effets de différents facteurs sociaux externes sur l'usage directe et indirecte d'un système d'information organisationnel. Les résultats d'une enquête menée auprès de 102 médecins dans un hôpital public révèlent que la punition et l'influence informationnelle sont significativement liées à l'usage direct du système d'enregistrement médical électronique (EMRS). La punition et l'image sont significativement liées à l'usage indirect du système.

Introduction

Studies on Information System (IS) usage have been abundant. For instance, between 1992 and 2007, 39 articles on IS usage were published in *MIS Quarterly* and *Information Systems Research* journals. This constitutes one third of

the total publication space in the two journals (Barki et al. 2007). Despite the high degree of research interest in IS usage, these studies have traditionally examined a user's direct interaction with a system and seldom did these studies differentiate between direct use and indirect use (Boffo and Barki 2003; Doll and Torkzadeh 1998). In this study, we define an individual's direct interaction with the system as "direct-usage", with reference to the situation when a user independently uses an IS to accomplish an organizational task. Indirect use is termed as "indirect-usage", which is the state in which a user employs an IS indirectly through one or more intermediaries (i.e., other colleagues) to accomplish an organizational task. Direct and indirect usage differs when viewed from the behavioral perspective. For instance, direct-usage requires substantial learning effort of a user. Comparatively, in an indirect-usage situation, a secondary user (e.g., a secretary) "represents" the primary user (e.g., his/her manager) in using an IS. Hence, in the indirect-usage situation, the primary user, i.e., the manager, is not required to expend significant learning effort. Given the above varying characteristics, these two forms of usage behavior are unlikely to be influenced by the same antecedents, or in the same manner for that matter.

The importance of studying indirect IS usage is best exemplified by Kraemer et al. (1993). In this study involving 260 public managers, the authors observed that those who allowed support staff to mediate their IS work expressed a higher satisfaction with the usefulness of computer-related information. The authors further added that such indirect IS use could be common (Kraemer et al. 1993). Indeed, there exists a significant proportion of IS users across various cultures (e.g., Americans and Asians), industries (e.g., manufacturing, service and public sectors), and positions (e.g., managers and physicians) who may choose to delegate their IS-related work, e.g., data entry, to others (Horan et al. 2006; Khalid et al. 2002; Kraemer et al. 1993; Nolan 1998). Despite the distinctiveness and ubiquity of indirect-usage in an organizational context, to our best knowledge, no prior study has scrutinized this construct yet. The question to ask next is what leads to direct-usage or indirect-usage of an IS? Our review of extant literature on post-IS implementation suggests that the use of an IS within an organization is, in part, subjective and socially structured (Fulk et al. 1990). In other words, a user's actual IS usage could be substantially influenced by social factors inside the organization (Fulk et al. 1990; Malhotra and Galletta 2005).

Research on the impact of the social influence from external agents on behavioral intention has presented empirical studies of mixed findings (e.g., Davis 1989; Venkatesh and Morris 2000). For instance, Davis et al. (1989) found that social influence does not significantly affect a user's behavioral intention (Davis et al. 1989). However, other studies reported a positive relationship (e.g., Schmitz and Fulk 1991). In reconciliation of the mixed findings, some researchers have suggested that the inconclusive findings may stem from a narrow, uni-dimensional conceptualization of social influence (Rivis and Sheeran 2003). Concerning this argument, we are seeing more studies, which consider social influence from a multi-dimensional perspective (e.g., Malhotra and Galletta 2005). Despite the presence of these studies, it is still unclear how different social factors originating from various influential sources, such as the relationship between coworkers and supervisors, can affect actual usage behavior.

This study, hence, attempts to fill the research gap by drawing upon the psychological attachment theory to identify and examine key social determinants of a user's direct and indirect usage of an IS (Kelman 1958). Essentially, this study seeks to answer the following research question: What social influence factors are important in determining an organizational user's direct and indirect usage of an IS?

We validated a theoretically constructed research model using data collected from a public hospital in China, which houses physicians who directly use a healthcare IS and those who interact with a healthcare system indirectly by allowing their assistants to assess data in the system (Horan et al. 2006; Nolan 1998). In the public hospital we studied, physicians are supposed to use an IS, commonly known as the Electronic Medical Record System (EMRS). EMRS is a complex healthcare information system, which is touted to help the hospital to substantially improve service quality and reduce costs (Miller and Sim 2004). Although patients' medical records (e.g., prescriptions, test orders) can be stored electronically within the EMRS, digital signatures of medical records are not legal in China yet. In other words, to comply with the government's medical regulations, all records have to be printed and personally signed by the relevant physicians. Thus, some physicians may choose to delegate their system-related work to others and verify the accuracy on the printed paper. Our results offer strong empirical support concerning the effects of social influence factors on a physician's direct and indirect usage of the EMRS.

Electronic Medical Record System (EMRS)

The most noticeable evidence of the proliferation of Information Technology in the healthcare industry would probably be the widespread adoption of the EMRS (Chiasson et al. 2006). An EMRS typically serves as an

electronic infrastructure for hospital users, such as physicians and nurses, to record, store and process various types of clinical, administrative and financial data of their patients (CPRI 1996; Dansky et al. 1999). Table 1 presents some of the typical functions provided by an EMRS (Miller and Sim 2004). Although the functions of the system may vary across different vendors, most of the comprehensive EMRSs support computerized viewing, prescribing, ordering, billing, and documentation (Altomare 2006; Ash and Bates 2005; Bates et al. 2003).

Table 1. Activities supported by EMRS

Activity	Description
Viewing (Standard)	Facilitates the viewing of electronic patient records *(including previous history, laboratory order results and etc.)* in various formats *(e.g. charts, and tables)*
Documentation and care management (Standard)	Facilitates the entering of progress notes by providing templates, including electronic problem lists, allergy lists, documentation prompts, and etc.
Prescribing and ordering (Standard)	Enables electronic prescribing *(i.e. typing in prescriptions, responding to drug reactions and drug allergy alerts, and printing prescriptions)* and ordering *(i.e. typing in laboratory and radiology test orders, transmitting instructions and tracking test-order status / results)*.
Billing (Standard)	Automatically generates bills according to the prescriptions and/or the instructions.
Analysis and reporting (Standard)	Allows physicians to query patients' records and generate reports. Can also be used to monitor physicians' performance and provide feedback *(less used)*.
Messaging (Standard and Advanced)	Sends electronic messages among hospital stakeholders *(standard)* or to external providers and patients *(advanced feature)*.
Patient-directed functionality (Advanced)	Enables patients to schedule visits, send secure e-mail messages to providers, receive e-mail reminders, order medications, access charts, and obtain more individualized educational patient care information.

Hospitals that adopt an EMRS could benefit from significant costs savings (Sachs 2003). Firstly, with electronic documentation, order and storage, the costs on dictating to personal assistants, paper, and physical storage of patients' records can be substantially reduced. Secondly, drug costs can be reduced when physicians are able to identify the least expensive drugs within a category from the EMRS. Thirdly, the occurrence of redundant laboratory tests can be minimized when information on test costs, previous test results, and appropriate reminders are readily available. Finally, physicians can make more efficient decisions as the information within the EMRS is legible and available any time without any restrictions on location (Bates et al. 2003).

Besides cost benefits, a hospital's service quality can be improved by introducing an EMRS (Bates et al. 2003). Firstly, electronic care management (e.g., reminders) alerts physicians of the upcoming care events. Secondly, computerized prescribing improves healthcare safety standards. By using templates such as drug prompts, physicians could reduce medication error rates (Bates et al. 1999). Thirdly, existent abnormal results are monitored and tracked in an EMRS. This ensures appropriate follow-up care. Fourthly, reports generated by an EMRS facilitate hospital management in regularly and systematically conducting quality comparisons. With such benefits, EMRS and other health information systems are embraced by hospitals worldwide (Chiasson and Davidson 2004; Freudenheim 2004).

While convincing hospital decision-makers of the importance of having an EMRS could be less difficult judging from the widespread adoption of such systems, getting the employees to utilize the EMRS might be a more difficult achievement (Ash et al. 1998; Reed and Grossman 2004). It was found that in the United States, among hospitals that have adopted EMRS, less than 15 percent of their employees really used the system (Freudenheim 2004).

Computerized physician order entry (POE), an essential component of an EMRS, was completely or partially available in one-third of all United States hospitals. However, more than half of hospitals reported fewer than 10% usage by physicians and the total number of orders entered by POE was under 10% (Ash et al. 1998). Many EMRS initiatives have failed, resulting in hospitals incurring significant financial loss (Freudenheim 2004; Kuhn and Giuse 2001). Such a phenomenon is not unique to healthcare systems; it was also observed in other organizational applications, such as CASE technology (Purvis et al. 2001; Kemerer 1992) and Customer Relationship Management Systems (CRMS), according to Rigby et al (2002). Researchers refer to such observations as the assimilation[1] gap: it exists when the pattern of cumulative assimilation lags far behind the pattern of cumulative acquisition/adoption (Fichman and Kemerer 1999).

What are the barriers to EMRS assimilation? Studies have suggested that physicians' resistance is one of the most critical barriers to EMRS assimilation (Meinert 2005; Wilson 1997). Among various reasons for resistance, physicians' cost-benefit asymmetry is prominent. When an EMRS is successfully deployed, most financial benefits are accrued to patients and hospital management, not the principal users of the system, i.e., the physicians (Ash and Bates 2005; Bates et al. 2003). This misalignment results in physicians either actively resisting the implementation or passively using only limited system functions (Lapointe and Rivard 2005). Different from the adoption stage when the decision to purchase a system is made by the top management, the assimilation of an IS innovation depends on the extent of users' appropriately using the system in their daily work (Lewis et al. 2003). Thus, understanding factors that influence physicians' utilization of EMRS is of paramount importance to address the challenges of organizational IS assimilation in general, and EMRS assimilation in particular.

Theoretical Background and Hypotheses

To yield a holistic view of physicians' utilization of an EMRS, both direct-usage and indirect-usage should be taken into consideration. Physicians, whose work involves many pressures related to decision-making and time constraints, may treat the direct-usage of EMRS as an extra burden. In addition, with the prominent power possessed by these physicians within the hospital, they can choose to delegate the usage of the system to others, such as their assistants or administrative personnel (Nolan 1998). Physicians are found to have a tendency to accept an innovation if it is introduced by their coworkers (Gremy et al. 1999). The preliminary review of extant literature suggests social influences from external agents are important antecedents leading to the usage of EMRS.

This study adopts the psychological attachment theory as the theoretical underpinning for examining a user's susceptibility to external pressures. The psychological attachment theory, developed by Kelman (1958), identifies and explains the different social influence factors that affect an individual's behavior. This theory is based on the assumption that the effect of social influences on individual behavior exist at different levels. On their part, these different levels reflect the various processes by which an individual adopts the induced behavior. The psychological attachment theory was originally used to study social issues. Recently, researchers have started to adopt Kelman's framework in the context of individual IS use within an organization (e.g., Malhotra and Galletta 2005). Various social influence processes may occur in such a context. For instance, a manager may use rewards and punishments to advocate the use of the technology (Purvis et al, 2001). Individuals, who decide to comply with this strategy, are affected by a compliance process. Individuals could also choose to use the technology because they want to establish a positive image among coworkers or alternatively, they could have come to realize the importance of using the system from the behavior of others in the same organization. According to Kelman (1958), an individual's attitude can be affected by social influences through three conceptual mechanisms namely: compliance, identification and internalization.

The research model, in Figure 1, depicts the effects of the three social influence mechanisms on a physician's use of EMRS. Four independent variables, i.e. reward, punishment, image, and informational influence are hypothesized to affect two types of EMRS usage behavior, i.e., direct-usage and indirect-usage of EMRS. Socio-individual factors (age), perceived ease of use and perceived usefulness are set as control variables.

[1] IS assimilation refers to the process whereby "the use of a technology diffuses across organizational work processes and becomes routinized in the activities associated with those processes" (Chatterjee et al. 2002 p.66).

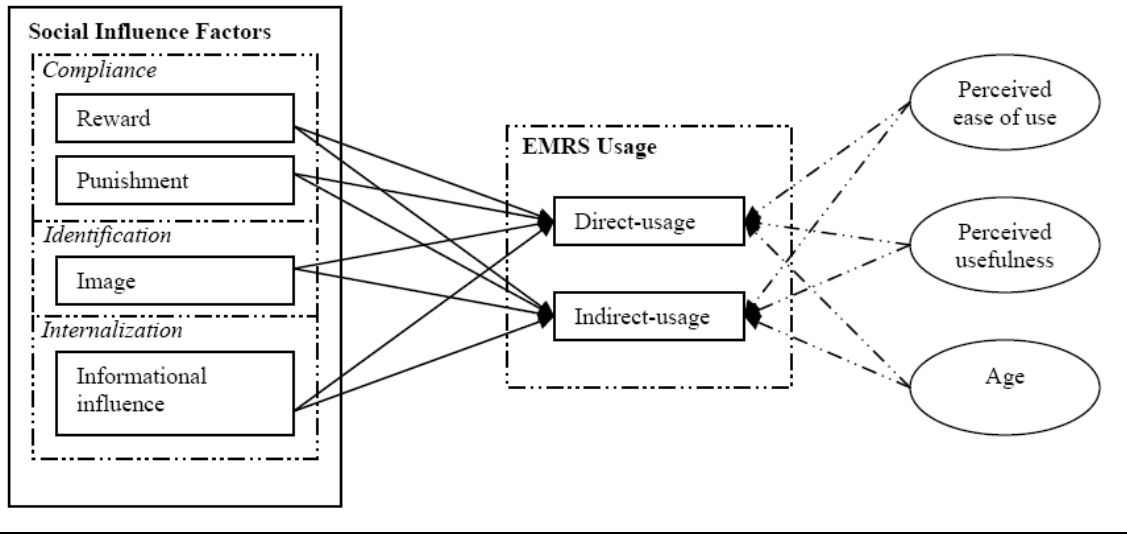

Figure 1. Research Model

Compliance (Reward and Punishment)

A compliance process occurs when an individual assents to a particular request from others in order to gain specific rewards or avoid specific punishments. This process takes place "whenever an individual perceives that a social actor wants him or her to perform a specific behavior, and the social actor has the ability to reward the behavior or punish non-behavior" (Venkatesh and Davis 2000, p.188). In this situation, adopting the induced behavior is not due to one's belief in the content but is meant as a means of obtaining favorable outcomes or avoiding undesirable outcomes from another person or group (O'Reilly and Chatman 1986).

French and Raven (1959) suggest that reward and punishment are two important sources of one social entity's influence over another. When individuals perceive that a powerful person expects them to adopt a certain kind of behavior, they may behave accordingly. This is because they want to maximize reward by complying or minimizing punishment by not deviating from the expected behavior (Gaski 1986; Kelman 1958).

In IS usage literature, an organization's top management or supervisors often "encourage" employees to use a new IS by either providing reward/punishment explicitly or engaging in persuasion implicitly (Purvis et al. 2001). When an individual perceives such expectations from senior managers, he/she may choose to perform the induced behavior based on the need for approval or to avoid disapproval (Bagozzi and Lee 2002). In the context of this study, the use of EMRS is often associated with a physician's performance assessment in some hospitals (Bates 2005). Supervisors, serving as champions, may persuade or implicitly promote the use of EMRS. Therefore, a physician may decide to comply with the management or his/her supervisor's expectations by directly using the system without privately/personally accepting the system (Malhotra and Galletta 2005).

While the above discussion suggests a positive relationship between reward/punishment and direct-usage of EMRS, the effects of these two social factors may be negative for indirect-usage of EMRS. In the current context, the physicians are supposed to use the EMRS, either directly or indirectly. The supervisor may interpret indirect-usage as a sign of reluctance to his/her request. In such circumstances, indirectly using the system may cause a physician to receive the disapproval from the supervisor or fail to get rewards from the hospital management. To reduce such undesirable outcomes, the physician may not be willing to delegate his/her EMRS use to other colleagues. Hence, we hypothesize:

H1a: Reward is positively associated with direct-usage of EMRS.

H1b: Reward is negatively associated with indirect-usage of EMRS.

H2a: Punishment is positively associated with direct-usage of EMRS.

H2b: Punishment is negatively associated with indirect-usage of EMRS.

Identification (Image)

Identification, also known as affiliation, occurs when an individual decides to accept an external social influence in order to forge a desired relationship, in other words, to "establish or maintain a satisfying self-defining relationship with another person or group" (Kelman 1958, p.53). This form of social influence is often related to the desire to gain *image* or recognition within a social group (Venkatesh and Davis 2000). Similar to compliance, an individual adopts the behavior without accepting its content.

Image is defined as "the degree to which use of an innovation is perceived to enhance one's image or status in one's social system" (Moore and Benbasat 1991, p.195). An individual tends to engage in certain behaviors as a means to enhance self-esteem within a reference group (Cialdini and Goldstein 2004; Kelman 1958). In a working environment, increased status within a group is closely associated with the basis of power and influence, also referred to as "referent power" (French and Raven 1959; Venkatesh and Davis 2000). Therefore, an individual may choose to accept the induced behavior because it can elevate him or her within the group. Due to the complexity of EMRS, physicians who are willing to use it in their daily work would probably gain recognition among their peers. In such circumstances, they may decide to use the EMRS in order to attain a positive reputation regardless of whether the usage is direct or indirect. Thus, we hypothesize a positive relationship between image and the two types of EMRS usage. Specifically,

H3a: Image is positively associated with direct-usage of EMRS.

H3b: Image is positively associated with indirect-usage of EMRS.

Internalization (Informational Influence)

The internalization process is associated with agreement on the content of an induced behavior. When receiving persuasions from other people or observing their behavior, an individual may consider that adopting the same behavior is useful for the solution or his/her needs. As a consequence, he or she chooses to accept the influence "because it is congruent with his/her value system" (Kelman 1958 p.53).

Informational influence is defined by Deutsch and Gerard (1955, p.629) as an "influence to accept information from another as evidence about reality". In this context, an individual adopts a behavior based on the desire to accurately interpret the reality and behave appropriately (Cialdini and Goldstein 2004). In other words, the content of behavior is congruent with his or her value system and is intrinsically rewarding (Kelman 1958). Previous literature suggests that the behavior of coworkers can influence an organizational user's decision to use an IS (Venkatesh and Davis 2000). When physicians observe that their coworkers are using the EMRS, their judgment may be influenced by the decisions of others, and they would begin to believe in the value of the system (Fulk et al.1990; Venkatesh and Davis 2000). As a consequence, they may use the system as it is congenial to their needs. We do not expect the effect of informational influence on physician's EMRS usage to differ between direct and indirect usage. Thus, we hypothesize:

H4a: Informational influence is positively associated with direct-usage of EMRS.

H4b: Informational influence is positively associated with indirect-usage of EMRS.

Control Variables

To test the proposition that direct and indirect usage of EMRS by physicians is systematically related to social influence factors, we include three control variables: Age, Perceived usefulness (PU), Perceived ease of use (PEOU)); that have been found in previous studies to influence system usage (Davis 1989; Laguna and Babcock 1997; Rousseau and Rogers 1998).

Research Methodology

Survey methodology was used in this study to test our model because it provides a basis for establishing generalizability to the population under observation or other similar populations; allows results to be easily replicated; and has statistical power (Neuman 2003). In our study, the unit of analysis is the individual physician in

the hospital. We aim to explain and predict the behavior of individual physicians with regard to their direct and indirect usage of EMRS. A field survey was conducted at a large public general hospital in China, which started implementing the EMRS in all in-patient departments the year before we conducted our survey. The duration of each physician's EMRS use within the study period, varied from one month to one year, depending on the actual time each corresponding department began utilizing the system. Physicians were expected to use the system to some extent, either directly or indirectly, in the course of their daily work. The choice of a single organization determined the effects of organizational level variables (such as different EMRS packages and hospital size) on individual usage behavior. In line with previous literature (for instance, Karahanna et al. 1999), this selection strategy is more effective in detecting micro level effects.

Table 2. Operationalization of constructs

Constructs	Items	Scale
Reward	How hard I work on using the EMRS is directly linked to _____ 1. how much I am rewarded by the hospital's management 2. how much I am recognized by my supervisor	7-point Likert scale (O'Reilly and Chatman's 1986)
Punishment	1. In order for me to avoid punishment in my job by the hospital's management, it is necessary to use the EMRS. 2. If I do not use the EMRS, my supervisor will not acknowledge me.	7-point Likert scale (O'Reilly and Chatman's 1986)
Image	Using the EMRS improves my image among my _____ 1. departmental peers 2. hospital's peers outside my department 3. professional peers	7-point Likert scale (Venkatesh and Davis 2000)
Informational influence	Based on my observation of my _____, what the use of the EMRS stands for is important to me. 1. departmental peers 2. hospital's peers outside my department 3. professional peers	7-point Likert scale (Self-developed indicators)
Direct/indirect usage	1. I often utilize the EMRS in my work. 2. When I need to utilize the EMRS, I will _____ (you can choose more than one answer) [___] use it on my own initiative. [___] let other people use the system for me. 3. If you choose both in Qn2, how often do you use it on your own initiative when you are utilizing it? (1: Rarely 7: Every time)	7-point Likert scale for questions 1 and 3 (Self-developed indicators)
Perceived usefulness (PU)	1. Using the EMRS improves the quality of my work. 2. Using the EMRS enhances the effectiveness of my work. 3. Using the EMRS enables me to accomplish my tasks more quickly.	7-point Likert scale (Venkatesh and Davis 2000)
Perceived ease of use (PEOU)	1. Learning to operate the EMRS is easy for me. 2. My interaction with the EMRS is clear and understandable.	7-point Likert scale (Venkatesh and Davis 2000)
Age	1. What is your age? Below 24 [__] 24-29 [__] 30-34 [__] 35-39 [__] 40-44 [__] 45-50 [__] Over 50 [__]	Interval

As far as possible, we measured our constructs using validated questions from previous studies to facilitate the validity of measures and facilitate comparison of results across studies. Where this was not possible, new questions were developed based on a review of the relevant literature and were subsequently tested for validity. All external

social influence constructs (i.e. reward, punishment, image and informational influence) were operationalized as formative, emergent constructs formed by influences from important sources (viz., hospital management, supervisors, departmental peers, hospital peers outside the department, and professional peers), which were less assessed in previous measurements of multidimensional social influences. The multiple sources of social influences were adapted from Lewis et al. (2003) and modified to suit our context. The rationale is that different salient sources may exert different influences on an individual physician. For instance, a physician may be willing to get recognition from his/her supervisor but might not be very interested in receiving rewards from the hospital management. We measured the physician's age by asking respondents to indicate a range instead of a specific number. This design was adopted to minimize the discomfort that respondents might receive from answering sensitive questions. Table 2 summarizes the operationalization of constructs examined in this study.

The two dependent variables are direct-usage and indirect-usage of EMRS. As we failed to find a validated scale that could simultaneously measure these two constructs, we developed a scale based on definitions and concepts used in MIS research. In line with previous literature (e.g., Davis 1989), frequency of use is considered as a better indicator of extensiveness of usage than other measurements, such as the number of hours spent on using the system and the number of tasks employed. In Table 2 (on direct/indirect usage), the first question measures the frequency of overall EMRS usage regardless of whether the usage is direct or indirect, by means of a seven-point Likert scale. The second question is used to check a user's usage type (direct, indirect or both). The third question is used to measure the frequency of direct-usage when a physician utilizes the system. The frequency of direct-usage is calculated as follows: First, if a user only uses the system directly (the first choice in question 2), the value of direct-usage is the frequency of overall usage (question 1). Second, if a user uses the system only indirectly (the second choice in question 2), the value of direct-usage is the minimum value of 1. Third, if a user uses the system in two ways (i.e. directly and indirectly), the value of direct-usage is the frequency of overall usage (question 1) multiplied by the frequency of direct-usage when the user utilizes the system (question 3). The formula ensures the result of the calculation is still in the range of 1 to 7. For instance, if a user moderately utilizes the system in his/her work (a score of 4 in Q1) and he/she has slightly more frequent direct-usage compared to indirect-usage (a score of 5 in Q3). Then the frequency of direct-usage is 3 = ((4-1)*(5-1)/6) + 1. The frequency of indirect-usage is calculated similarly. The complete formulae are presented in Table 3.

Table 3 Calculation of scores of dependent variables

Answer for Q2	Scores for Direct/Indirect Usage	
	Direct	**Indirect**
Direct only	Q1	1
Indirect only	1	Q1
Both	((Q1-1)*(Q3-1)/6) + 1	((Q1-1)*(8-Q3-1)/6) + 1

Q1=value of question 1; Q2=value of question 2; Q3=value of question 3

Conceptual Validation

Our survey instrument was first tested by consulting several colleagues to identify and rectify potential problems due to the framing and phrasing of the questions. To enhance the conceptual validity, we conducted one unlabeled and one labeled sorting session by recruiting postgraduate IS students (6 for each session). Minor modifications were made on some items to address the concerns raised by the 'judges'. Next, the questionnaire was translated into Chinese and then retranslated into English by two independent postgraduate students. The authors compared the translated version with the original questionnaire and made changes when necessary. To ensure face validity, the CIO of the surveyed Chinese hospital and two of its experienced physicians were asked to comment on the survey questionnaire and highlight questions that were confusing or difficult to answer. Based on their suggestions, we made some modifications in our description of the EMRS as well as in the phrasing and framing of the questions.

Survey Administration

Our survey package consisted of a cover letter stating the objective of the study and the survey questionnaire. The description of the EMRS was included in the survey instrument to improve the validity of responses. The survey

package was distributed to respondents by either the authors or survey collaborators in the hospital we surveyed. It was required that each participant must have prior experience in using the EMRS, either directly or indirectly with assistance from others. As an incentive, 10 yuan (equivalent to US$1.5) was donated to a charity foundation in China for each completed questionnaire. Physicians who participated in the previous short interviews were excluded from the study. To protect the privacy of the respondents, no personally identifiable information, such as name or email address was required for the survey. The authors made follow up calls and visits to survey collaborators in the hospital to increase the response rate. Among the 200 questionnaires sent out, 121 responded, yielding a response rate of 60.5%. This response rate is satisfactory given the tight schedules of the physicians. Nineteen incomplete responses were excluded from further analysis because we could not recover the missing data due to the anonymous nature of our survey. A total of 102 entries were recorded.

Table 4 Demographic information

Variables	Category	Frequency (n=102)	Percent
Gender	Male	54	52.9
	Female	48	47.1
Age	<24	1	1.0
	24-29	60	58.8
	30-34	17	16.7
	35-39	9	8.8
	40-44	7	6.9
	45-50	5	4.9
	>50	3	2.9
Education	Middle school	0	0
	High school	2	2
	Bachelors degree	86	84.3
	Masters degree	10	9.8
	Doctorate	4	3.9
Number of years working in the current hospital	0-2	39	38.2
	3-5	23	22.5
	6-8	12	11.8
	9-11	10	9.8
	12-14	9	8.8
	>15	9	8.8
Work experience (year)	0-2	39	38.2
	3-5	21	20.6
	6-8	12	11.8
	9-11	12	11.8
	12-14	7	6.9
	>15	11	10.8
Seniority	Chief physician	7	6.9
	Assistant chief physician	13	12.7
	Attending physician	23	22.5
	Resident physician	23	22.5
	Intern	35	34.3
	Others	1	1.0

Data Analysis

Table 4 presents the demographic information of the survey respondents. Unlike western countries, a physician's entry level qualification is a bachelor's degree in the Chinese healthcare system. Older physicians usually do not hold higher degrees due to a previous lack of opportunities for higher healthcare education. Younger physicians with higher educational backgrounds are usually assigned to top-ranking hospitals (i.e., 3A hospitals) located in large cities. Structural equation modeling (SEM) was used in our hypotheses testing because it allowed for indicators to register different weights of the construct estimates (Chin et al. 2003). Partial list squares (PLS) maximized the variance demonstrated by the constructs and enabled latent variables to be either formative or reflective. Since our research was prediction-oriented and most of the independent variables were modeled as formative, emergent constructs, we used PLS which was implemented in the smartPLS version 2.0.M3. Tables 5 and 6 depict the descriptive statistics and the inter-correlation of the studied variables, respectively.

Table 5 Descriptive Statistics of Variables

Studied variable	Mean	Std Dev
Independent variables		
Reward	3.835	1.4586
Punishment	3.88	1.724
Image	3.38	1.626
Informational influence	3.94	1.630
Dependent variables		
Direct-usage	3.97	2.224
Indirect-usage	1.73	1.125
Control variables		
Age	2.88	1.381
PU	4.64	1.725
PEOU	4.59	1.743

Table 6. Inter-correlations among study variables

	1	2	3	4	5	6	7	8	9
Age (1)	1.000								
EOU(2)	-0.194	0.950							
Reward (3)	-0.168	-0.234	1.000						
Informational influence (4)	-0.264	0.456	-0.139	1.000					
Indirect-usage (5)	0.388	-0.125	-0.266	0.143	1.000				
PU (6)	-0.195	0.610	-0.212	0.536	0.119	0.936			
Punishment (7)	0.101	0.241	0.061	-0.053	-0.170	0.100	1.000		
Image (8)	-0.126	0.268	-0.187	0.478	0.294	0.322	0.004	1.000	
Direct-usage (9)	-0.319	0.640	-0.161	0.406	-0.466	0.519	0.256	0.058	1.000

Evaluating the Measurement Model

The strength of the measurement model was assessed by the convergent and discriminant validities of two reflective multiple-items constructs: perceived usefulness (PU) and perceived ease of use (PEOU). Convergent validity reflects the uni-dimensionality of the constructs and was assessed using item reliability, composite reliability of constructs, and the average variance extracted (AVE), according to Hair et al (1998). A score of 0.5 is the threshold to deem the AVE acceptable for a construct. Furthermore, the Cronbach's Alpha and composite reliability values should be greater than 0.707 (Nunnally 1978). Table 7 presents the test results for these two constructs. All scores were observed to exceed the acceptance levels, and this indicated good convergent validity.

Discriminant validity reflects the extent to which the indicators for each construct are distinctly different from indictors in other constructs, and was assessed using factor analysis and construct correlation in this study. Factor loadings of above 0.7 are considered good. As depicted in Table 8, all indicators loaded correctly on their intended construct than on the other construct. The second method is to assess whether the square root of AVE for a construct is larger than its correlations with other constructs. As shown in Table 6, both two reflective constructs satisfy this criterion. Generally, the results indicate strong evidence of convergent and discriminant validities.

Table 7. Assessment of Convergent Validity

Dimensions	Item Reliability	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
PU		0.9454	0.9344	0.8769
PU1	0.9541			
PU2	0.9655			
PU3	0.9285			
PEOU		0.8597	0.9649	0.9016
PEOU1	0.9378			
PEOU2	0.9352			

Table 8 Assessment of Factor Analysis

	Component	
	1	2
PEOU1	0.229	**0.922**
PEOU2	0.390	**0.845**
PEOU3	**0.926**	0.260
PU1	**0.911**	0.327
PU2	**0.864**	0.315

Testing the Structural Model

After confirming good psychometric properties, we next examined the structural model by assessing the explanatory power (R-square) and significance of paths using the PLS. All statistic tests were assessed at a five-percent level of significance using a one-tailed t-test because our hypotheses were uni-directional in nature. A bootstrapping procedure generating 200 random samples was used to assess the significance of path coefficients. Table 9 presents the results of PLS data analyses for three models: the theoretical model, the theoretical model with age and the full model including all control variables. For the direct-usage model, an R-Square value of 29.5% was obtained for the theoretical model and 54.8% was obtained when we included all control variables. For the indirect-usage model, an R-Square value of 16.0% was obtained for the theoretical model and 41.1% was obtained for the full model. The

results show that the significance of paths remained after adding in control variables. Therefore, the results of the hypotheses tests were reliable and independent of the influences from the control variables. Our examination of the theoretical and the full models reveals that out of 8 hypotheses, 4 were supported. Reward was not seen to have a significant relationship with both direct-usage and indirect-usage, i.e., H1a and H1b were not supported. Punishment was seen to have a significant relationship with direct-usage and indirect-usage, i.e., H2a and H2b were supported. Image was observed to have a negatively significant relationship with direct-usage and a positively significant relationship with indirect-usage, i.e., H3a was not supported while H3b was supported. Informational influence was seen to have a significant relationship with direct-usage, but not with indirect-usage, i.e., H4a was supported but H4b was not supported.

Table 9 Results of PLS Analyses: Path Coefficients and Variance Explained

	Theoretical Model without Control Variables	Theoretical Model with Age	Full Model with All Control Variables	Hypothesis Testing
Dependent variable: direct-usage				
Reward	-0.154	-0.224	-0.107	H1a was not supported
Punishment	0.296**	0.329**	0.186**	H2a was supported
Image	-0.209*	-0.220*	-0.237*	H3a was not supported
Informational influence	0.503**	0.415**	0.182*	H4a was supported
Age	-	-0.320**	-0.238**	
Perceived ease of use	-	-	0.406**	
Perceived usefulness	-	-	0.160*	
R-square	29.5%	38.7%	54.8%	
Dependent variable: indirect-usage				
Reward	-0.208	-0.103	-0.129	H1b was not supported
Punishment	-0.163*	-0.212*	-0.160*	H2b was supported
Image	0.265**	0.282**	0.275**	H3b was supported
Informational influence	-0.017	0.114	0.120	H4a was not supported
Age	-	0.477**	0.456**	
Perceived ease of use	-	-	-0.290*	
Perceived usefulness	-	-	0.229*	
R-square	16.0%	35.9%	41.1%	

* Significant at 5% level of significance ** Significant at 1% level of significance

Discussion and Implications

This research constitutes one of the first studies to systematically assess the antecedents of two types of individual IS usage behaviors (i.e., direct-usage and indirect-usage), an area that has received scant attention in the IS literature. As hypothesized, punishment and informational influence were significantly related to direct-usage of EMRS, while punishment and image were significantly associated with indirect-usage of EMRS. Generally, there is strong empirical support for our objective to highlight the effects of social influences from external agents on a physician's use of EMRS in a hospital. This is in accordance with previous studies, which suggest that the behavior exhibited by individual users utilizing an IS within an organization could be influenced by social factors (Rice and Aydin 1991).

It is interesting to note that the relationship between reward and use of an EMRS is not significant regardless of whether it is direct or indirect usage. A plausible reason is that a physician earns a decent salary and does not suffer from the problem of securing another similar medical position in other hospitals. Moreover, a physician could be suffering from tight consultation and/or surgery schedules, which deter him/her from using the system. The extra incentive from using the EMRS may not be sufficient to induce physicians to influence others to adopt it (i.e., indirect-usage). This could suggest that the effectiveness of incentives on employees could differ depending on the job categories. Another possible explanation is that the two sources (i.e., hospital management and supervisor) might exert different influences on EMRS usage. The weights of two 'reward' items showed contradictory signs (-0.860 and 1.013 for hospital management and supervisor, respectively). Future research could seek to validate this conjecture using model with second-order constructs.

Contrary to our hypothesis 3a and past studies, image reflected a negatively significant relationship with direct-usage of EMRS. A plausible explanation for this discrepancy is the cultural difference between the current context and prior studies, which are usually conducted in western societies. As our data collection occurred in a Chinese hospital, the unique characteristics of Asian, in particular, Chinese culture needs to be taken into consideration. When a physician is recognized as an EMRS expert, his or her colleagues or senior physicians would probably seek assistance or be more willing to delegate their work to him/her. Unlike western culture, people in China place great emphasis on the appropriate arrangement of interpersonal relationships (i.e., "guanxi") (Hwang 1987). Under such circumstances, refusing to comply with the requests of others would be considered as a threat to harmonious interpersonal relationships. Thus, to avoid unharmonious situations, it is less likely that a physician would refuse other people's requests. As a consequence, maintaining a positive image will create an extra burden for the physician.

We hypothesize that informational influence significantly influences direct-usage of EMRS. In line with social influence literature, we posit that an individual is willing to perform the induced behavior when its underlying value is congruent with his or her own value system (Kelman 1958). However, the relationship between informational influence and indirect-usage was not found to be significant. Therefore, when a physician accepts the underlying value of the EMRS, he or she may not choose to delegate work to others. Since previous literature has not examined indirect-usage, our findings structurally contribute further to the existing social influence literature by illustrating that informational influence may only affect the direct-usage of a system.

Our results also highlight an important socio-individual factor, i.e., we perceived that age did exert a strong influence on a physician's direct and indirect usage of EMRS. Prior literature has identified age as an important socio-individual predictor of IS use in the workplace (Laguna and Babcock 1997; Rousseau and Rogers 1998). Older people are less likely to directly use an IS primarily for two reasons. First, older people are unfamiliar with new technologies and find it more difficult to learn how to use an IS, compared with their younger peers because their cognitive abilities, such as learning and reasoning (Westerman et al. 1995). Second, age has long been recognized as an important basis for social power (French and Raven 1959). In certain cultures, aged people have legitimacy to prescribe various behaviors for younger people. A comparison between the theoretical model and the model including age shows that the latter model exhibits a substantive incremental variance of 19.9 percent on indirect-usage. Therefore, in addition to the social influences from external sources, future studies could explore the effects of influences/powers originating from a user in relation to his behavior with regard to direct and indirect usage.

Before proceeding to discuss the implications of our study, it is imperative that we specify the limitations. Specifically, while the present study may provide valuable insights into the direct and indirect usage of hospital systems, further research will be needed to obtain a deeper understanding of the effects of both forms of usage. First, this study surveyed only the physicians, which was the primary intention of this research. While there are very few extant studies on the healthcare system that are solely based on physicians, (which makes this study interesting and valuable), we realize that the results are not generalizeable to all hospital system users. Future research could seek to complement this study by surveying other hospital employees. Second, an examination of other antecedents, such as training and education, would enable the decision-makers in hospital management to effectively prepare the organization for more advanced and complex systems in the future. Third, the sole source of our data was a public hospital in China; thus we feel that the current research could be further replicated in a cross-country study because the differences in culture, economy and institutional pressures could all affect an individual's usage of a system. Fourth, there could have been other variables (such as learning behavior, leadership roles, etc.) that moderate the relationship between age and direct and indirect usage. Future research could seek to grasp a better understanding of the influence of age by examining these possible moderating effects. Fifth, due to the constraint of the sample size,

certain constructs contained only two formative items, representing different influence sources. Future research could use a larger sample size and each social influence factor could be modeled as second-order construct. Influences from each source could be modeled as first-order constructs. This could advance the assessment of different influences from different sources (e.g. supervisors or departmental peers).

Notwithstanding the limitations, which set the stage for future research, this study advances theoretical development in several ways. First, this study contributes to a broader conceptualization of IS usage constructs within an organization (Benbasat and Barki 2007). Related prior studies typically examine a set of antecedents towards a general usage behavior without explicitly considering indirect-usage, despite its distinctiveness and ubiquity. To our best knowledge, antecedents towards indirect IS usage have rarely been explored. This study, hence, constitutes one of the first studies to demonstrate different effects of social influence antecedents on direct and indirect usage. Our findings could serve as an exploratory study examining how organizational users (e.g., physicians in the current study) can adapt the original IS use behavior during the post-implementation (assimilation) stage, which is particularly useful when the system is mandatory within an organization.

Second, the results of this study demonstrate that different social influence factors theorized from the psychological attachment theory can significantly predict physicians' EMRS usage. This implies that findings from subjective norm could be complemented by studies using various social factors to offer a comprehensive and reliable representation of social influence. Towards this end, the multidimensional conceptualization of social influence also offers a possible answer to explain the ambiguous effects of this construct in previous literature (Davis 1989)

Third, we have also advanced the measurement of social influence factors by incorporating different sources, such as, departmental peers and supervisors. While the importance of considering different sources in social influence is well accepted, existing instruments do not consider this aspect (Malhotra and Galletta 2005; O'reilly and Chatman 1986). We believe our new measurement represents a better understanding of influences from various important sources.

Fourth, this study advances the theoretical development on the social influence literature by testing an individual's own influence (i.e., socio-individual factor) together with influences one receives from external agents (i.e., social influence factors). The results of this study unveil the important role of socio-individual factors (in this case, age) on the individual physician's use of EMRS. Therefore, future study could further explore the effects of an individual's own social influence on system usage behavior.

This study also offers important practical implications for hospital management staff. Essentially, we have demonstrated that physicians are subjected to influence from other people, such as their peers or supervisors. For hospitals keen on increasing physicians' use of the EMRS, they should place sufficient emphasis on promoting the system to the physicians. For instance, besides regulations and rules related to the EMRS use, senior physicians could also implicitly exert their power on junior physicians to increase the compliance influence.

In addition, hospital management decision-makers should utilize different strategies according to their objectives. For instance, if direct-use of the system is the target, champions should be identified among physicians to increase informational influence among other physicians. As older physicians tend to delegate the usage of EMRS to others (i.e., indirect usage), younger physicians are more likely to use the system on their own (i.e., direct-usage). Management decision-makers could adjust the marketing campaign according to the seniority of the employees to promote the usage of the new system. Should the goal be to increase greater IS usage, management decision-makers could provide older physicians with assistants to interact with the IS.

Conclusion

This research is one of the first studies in the IS field that systematically examines two types of IS usage behavior, namely, direct-usage and indirect-usage. Through developing and testing a theoretical model, this study advances our understanding of how multidimensional social factors (i.e. punishment, image and informational influence) can differently influence physicians' direct and indirect usage of the EMRS. Our results also inform practitioners, to be mindful of the factors influencing two forms of EMRS usage.

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