UNDERSTANDING THE IMPACT OF INDIRECT SYSTEM USE ON TASK PERFORMANCE IN HOSPITAL: AN AGENCY THEORY PERSPECTIVE

Yujing Xu, College of Business, USTC-CityU Joint Advanced Research Centre, University of Science and Technology of China, City University of Hong Kong, Hong Kong, xyujing2-c@my.cityu.edu.hk

Yu Tong, College of Business, City University of Hong Kong, Hong Kong, yutong@cityu.edu.hk

Stephen Shaoyi Liao, College of Business, City University of Hong Kong, Hong Kong, issliao@cityu.edu.hk

Yugang Yu, School of Management, University of Science and Technology of China, China, ygyums@gmail.com

Abstract

Indirect system use refers to a user (the principal) performs IS-related tasks via another user (the agent). Despite the prevalence of indirect system use, the extant literature on system usage and its performance mainly focuses on direct system use. During the process of indirect system use, the goal conflict and information asymmetry could arise between the principal and the agent, which create challenges of appropriately managing the agent's behavior. Drawing on the Agency theory, we propose that indirect system use can be categorized into two types: behavior-oriented indirect system use and outcome-oriented indirect system use. A conceptual model is constructed to theoretically understand how these two types of indirect system use impact task performance differently and contingent on the extent of task complexity.

Keywords: Behavior-oriented indirect system use, Outcome-oriented indirect system use, Task performance, Task complexity, Agency theory.

1 INTRODUCTION

Information systems (IS) within organizations are platforms that enable individuals to store and access vast amounts of codified knowledge and apply that knowledge to provide solutions to organization's needs (Van de Ven 2005). Through interacting with IS, various approaches can be provided for organizations to address managerial problems (Kim and Malhotra 2005). Based on whether a user accesses to IS directly, IS usage can be categorized into two categories: *direct system use* and *indirect system use*. According to Tong et al. (2008), *direct system use* means that an individual user interacts with IS by his/herself to accomplish organizational tasks, (b) *indirect system use* denotes the behavior that an individual user employs IS indirectly through intermediaries (e.g., secretaries, assistants) to accomplish organizational tasks. Both direct and indirect interaction between user and system are at the core set of properties of IS discipline (Benbasat and Zmud 2003). However, the extant literatures in system usage and its performance mainly focus on direct system use, and seldom take indirect system use into consideration.

In fact, indirect system use has become pervasive in our daily work (Burton-Jones and Gallivan 2007). System users are often found to ask others (e.g., subordinates or secretaries) to help them access an IS for data entry or managerial decision making. For example, senior physicians may ask their assistants to perform e-ordering and e-prescribing on their behalf to alleviate the heavy workloads (Tong et al. 2008). Some managers, when do decision making, tend to let secretaries perform IS-related tasks such as information searching (Kraemer et al. 1993). Prior literature implies a close linkage between indirect system use and performance. Kraemer et al. (1993) found that while direct system use and indirect system use concurrently appear in managers' work, indirect system use leads to a better satisfaction of those managers. Kane and Alavi (2008) examined the function of all direct and indirect system user-system interactions in a healthcare organization, and concluded that indirect interaction would significantly and positively associate with organizational performance outcomes. Sykes et al. (2011) discovered a positive contribution of indirect system use on physicians' performance by testing the individual interactions within a social context.

Despite the positive impact, agency theory alerts that indirect system use may bring in some deviations due to the agency problems. Indirect system use can be viewed as a kind of agency since it is a process that a user delegates some IS-related tasks to another user who directly interact with IS to perform these tasks. The designated user is the principal, and the user who performs these tasks is the agent. The agent's behavior may departure from the principal's expectation during the process of accomplishing these IS-related tasks due to the goal conflict and information asymmetry between principal and agent (Eisenhardt 1985).

The neglect and vacancy of research on indirect system use and its consequence make it hard for us to have a comprehensive view about IS usage. Hence, this study attempts to draw on agency theory to fill the research gap. From its roots in information economics, agency theory is concerned with resolving goal conflict and information asymmetry in principal-agent relationship (Jensen and Ruback 1983). To minimize the potential agency problems, different control mechanisms governing principal's and agent's cooperation are proposed in agency theory (Eisenhardt 1989). Leveraging on agency theory, we identify two control mechanisms that can organize the relationship between the principal and the agent during indirect system use: behavior control and outcome control. Based on these control mechanisms, we further categorize indirect system use into behavior-oriented indirect system use and outcome-oriented indirect system use. Thus, this study seeks to answer the research question:" How do the two types of control mechanisms-oriented indirect system use, i.e., behavior-oriented and outcome-oriented indirect system use, affect task performance?"

To address this research question, we propose a conceptual model to elaborate the effect of behavior-oriented and the outcome-oriented indirect system use on task performance in different manners. Although the conceptual model is designed in general organizational setting, we choose to tap on the inpatient department in hospital to illustrate the conceptual model. In the hospital setting, physicians often indirectly interact with Hospital IS (HIS) via their assistants. Through understanding the indirect system use in hospital, this study will give us some insights about how to manage the indirect system use efficiently.

2 INVESTIGATIVE CONTEXT—INDIRECT SYSTEM USE IN HOSPITAL

2.1 Use of HIS

HIS is an information system that provides the administrational needs for hospital, e.g., organize and store medical records electronically. Nowadays, HIS, including Electronic Medical Record System (EMRS) and Computerized Physician Order Entry (CPOE) have been extensively adopted since their significant benefits in cost savings and efficiency improving (Kazley and Ozcan 2008; Poissant et al. 2005; Poon et al. 2010). Besides, hospital also can improve its service quality by employing various HISs (Bates et al. 2003). Physicians can make decisions more efficiently, as the information within the HIS is available any time without any restrictions on location. The features of HIS may vary due to the different hospitals, but the main functions are similar. Table 1 presents the main functions of HIS.

Activity	Description
Viewing	Facilitates the viewing of electronic patient records in various formats
Documentation and care management	Facilitates the entering of progress notes by providing templates, including electronic problem lists, allergy lists, documentation prompts, and etc.
Computerized prescribing and ordering	Enables electronic prescribing and ordering
Analysis and reporting	Allows physicians to query patients' records and generate reports
Messaging	Sends electronic messages among hospital stakeholders

Table 1. Main functions of HIS

These functions make it more convenient for the physicians to give treatments to patients. With these functions of HIS, hospital can reduce the costs of physical storage of patients' records and provides better services to the patients (Bates et al. 1999). For example, computerized prescribing and ordering ensure the healthcare safety by following certain standards and electronic reports facilitate hospital management regularly and systematically (Tong et al. 2008). More importantly, HIS promotes the flow of information within hospital. Therefore, physicians' usage of HIS is of paramount importance to work performance.

Scholars have recognized the influencing contributions of HIS on hospital outcomes depends greatly on the degree to which physicians interact with systems (Blumenthal 2009). Many studies have investigated physicians' adoption of HIS, but most of their works are concentrated on the direct system use (Black et al. 2011; O'Connor et al. 2011; Poissant et al. 2005; Welch et al. 2007). O'Connor et al. (2011) found that interacting with an HIS directly could significantly improve physicians' control of patient care by conducting a clinic-randomized trial. Welch et al. (2007) identified that the implementation of the HIS had a modest positive impact on the quality measure of guideline adherence for hypertension and hyperlipidaemia. These studies have confirmed the pivotal role of HIS in hospital operation with the conclusion that the more physicians use the IS available to them, the greater achievement they are likely to obtain (Kane and Alavi 2008).

2.2 HIS and Indirect system use

IS researchers have traditionally focused on the ways in which users' own accesses to IS affect performance outcomes. Such conceptualization of user-system interaction does not consider the potential effect of indirect user-system interaction, making it hard for us to have a comprehensive view about IS usage.

In fact, expect for employing HIS by themselves, some physicians, especially those who are senior, may choose to let their assistants to help them perform some HIS-related tasks and then verify what

their assistants have done. According to a nationwide physicians investigation conducting by Horan et al. (2005), 57.4% of the physicians admitted that they often dictate reports to transcription services. In addition, 25.6% of respondents indicated that they would let their assistants to help them perform HIS-related tasks. The indirect interaction with HIS through asking others to perform HIS-related tasks for them can be viewed as indirect system use. For convenience, the physicians who ask others to help them deal with HIS-related tasks will be called principal physicians, and the physicians who perform such HIS-related tasks will be called agent physicians in the following sections.

There are many reasons that lead to the indirect system use in hospital, and they can be summarized into four categories:

- Physicians not only need to take care of inpatients and perform operation, but also need to give outpatient service, and do other patient-centric tasks. They are anxious to provide a proper service for their patients, but can't give enough attention for every patients if they've shackled with such heavy workloads. So they regard other activities such as writing electronic medical records as administrative irritants (Fichman et al. 2011; Kane and Labianca 2011; Tong et al. 2008). To alleviate the heavy burden of busy work schedule and give more efficient care to patients, they have to ask the assistants to help them deal with the HIS-related task.
- Some physicians with limited computer literacy, especially those who are elder and have a low-quality qualifications, will choose to let others to help them perform HIS-related tasks to improve work efficiency and avoid embarrassment (Jensen and Aanestad 2007). Employing HIS by themselves takes them a lot of time, so they will try to avoid employing HIS themselves.
- For the senior physicians who value the hierarchy, the right to delegate HIS-related tasks makes them feel identified (Tong et al. 2008). Instead of accomplishing the trivial HIS-related tasks by themselves, it is ideal to use HIS indirectly.
- For the senior physicians who need to train junior physicians and interns, delegating HIS-related tasks to the trainees can help them quickly master how to treat patients. Then, the trainees will better acquire how to treat from conducting these delegating HIS-related tasks.

This study mainly focuses on the first category because it account for most proportions of indirect system use in hospital. The indirect interaction behavior with HIS liberates principal physicians from heavy workloads, and makes them concentrate on treating patients (Jensen and Aanestad 2007). Additional, as indicated in the fourth reason, the indirect system use can help senior physicians to cultivate and guide assistants, which will improve the assistants' treatment capability. In return, the assistants can share more workloads for the principal physicians. As a result, more and more physicians would like to adopt HIS indirectly through asking agent physicians to perform HIS-related tasks for them.

However, there remains some deviations between agent physicians' behaviors and principal physicians' expectations due to the agency problems (Eisenhardt 1989). On the one hand, the agent physicians, who perform the HIS-related tasks, may have totally different attitudes towards the indirect system use compared to the principal physicians. They have to bear more workloads result from the principal physicians' indirect system use, which goes against their expectation that accomplishing work at their own pace. On the other hand, there exists a possibility of adverse selection, which means that the agent physicians may not have the skills or ability to accomplish certain tasks. Each HIS-related task is important for addressing patient care (Kane and Alavi 2008), and their influence is detailed in Table 2 below. Under this circumstance, if the principal physicians don't have enough information about the agent physicians' behaviors, both efficiency and quality of patient care may reduce although indirect system use makes principal physicians themselves concentrate on patient care.

Tasks	Description	Influence on efficiency of care	Influence on quality of care
Writing electronic patient record	Record each patient's all information	Patient record helps physicians track patient medical condition, but it has to a lot time to writing electronic patient record.	Although patient record benefit physicians a lot, spending too much time on patient record wiring may make the physicians cannot concentrate on patient treatment.
Viewing electronic patient record	Viewing of electronic patient records, including previous history, laboratory order results and etc. in various formats	Viewing patient record can help physicians identify the treatment quickly.	Previous patient records help remind physicians' what treatments are recommended for patients, given their condition.
Computerized prescribing and ordering	Enables electronic prescribing	Types in prescriptions and laboratory and radiology test orders, transmitting instructions and tracking test-order status / results quickly.	Provides and organizes the results of the treatment, strongly influencing the quality of care provided.
Analysis and reporting	Query patients' records and generate report	Allows physicians obtain patients information quickly to monitor physicians' performance.	Through the feedback from analysis and reporting, physicians can have a comprehensive understand about patients' condition and suit the remedy to the case.
Messaging	Send electronic information among hospital stakeholders	Provides physicians valuable quick reference when information from other stakeholders is needed (e.g., consultation).	It help physicians remain aware of the current best practices for patient treatment.
Patient care management	Enables managing appointments, patient flow, and patient contact/benefits information.	This task is associated with schedule patients and monitor real-time patient flows, which compensate for physicians who may be behind.	This task is essential for identifying patients who require special follow-up care, an important factor for treating patient.

Table 2. HIS-related tasks

To ensure agent physicians behave correct, the principal physicians will apply different methods to avoid these deviations and obtain information about agent physicians' behaviors. Commonly, they make the agent physicians act in their interest through monitoring agent physicians' behaviors or verifying agent physicians' outcomes, corresponding to behavior control and outcome control respectively. These different control mechanisms result in two different indirect system use in hospital. Although previous studies presented that indirect system use can improve efficiency and quality of care in terms of social network theory (Kane and Alavi 2008; Sykes et al. 2011), it is still not clear that how indirect system use work in hospital with different control mechanisms.

Additionally, indirect system use is associated with task complexity, which is the central feature in determining healthcare activities performance (Vakkari 1999). Hence, in this study, we will explore the different impacts of different kinds of indirect system use on task performance in terms of task complexity. Fully understanding of physicians' indirect system use can help hospital and other healthcare shareholders employ IS more efficiently and effectively.

3 LITERATURE REVIEW

3.1 Agency Theory

To yield a holistic view of the impact of indirect system use on task performance in hospital when there exists goal conflict and information asymmetry between the principal physicians and their agents, this

study draws on the notion of agency theory as a theoretical foundation. Based on agency theory, we can examine the effects of both behavior- and outcome-oriented indirect system use on task performance in hospital.

The focus of agency theory is on determining the most efficient control mechanism directing principal-agent relationship. Agency theory is first proposed to study the delegation relationship between shareholders and managers in organization (Ross 1973). At present, it has been applied to explain a variety of business problems between organization and individual, individual and individual, and individual and machine etc. (Blumenthal 2009; Mahaney and Lederer 2003; Worsham et al. 1997). From its roots in information economics, agency theory is concerned with problem how to better organize relationship when one party (the principal) delegates tasks to another party (the agent) (Eisenhardt 1989). For example, Austin (2001) generalized the central problem in agency theory as how to motive the agent to behave in the interest of principal. As a result, the unit of analysis of agency theory is the contract (control mechanism)[1], relies on which the principal can make the agent to perform the HIS-related tasks in their interest (Jensen and Meckling 1979). Early studies in agency literature focused on incentive alignment and compensation policies (Sappington 1991). Empirical studies in this stream considered trade-offs between principal and agent in different contracts. Another major stream of agency theory is concerned with the agency problems, agency cost and efficacy (Shapiro 2005). The focus of such stream is on determining the most efficient control mechanism to direct principal-agent relationship in terms of factors such as principal-agent relationship, task characteristics, organizational environment and so on (Agrawal and Knoeber 1996).

The phenomenon of indirect system use is ubiquitous in our daily life and at every level of management in organization (Jensen and Meckling 1976). The core issue of delegation is the principal-agent relationship (Holmstrom and Milgrom 1991). According to Eisenhardt (1989), the main concern in principal-agent relationship can be summarized as goal conflict, information asymmetry and risk aversion.

- Goal conflict is inherent when individuals with different preferences engage in cooperative efforts. The existence of goal conflict may reduce the possibility that an agent is willing to behaves in the interest of the principal (Ross 1973). For example, the principal physicians seek to complete these HIS-related tasks quickly and effectively by letting agent physicians to perform these tasks. On the contrary, the agent physicians have different desires and goals towards these HIS-related tasks. They want to work at their own pace, avoid risking and obtain benefits. Under this circumstance, the agent physicians' behaviors may departure from their principal physicians' expectations.
- Information asymmetry makes principal difficult to verify agent's behavior and gives agent a chance to behave inappropriately (Demski and Feltham 1978). When the information is complete, behavior of the agent can be easily observed by the principal (Eisenhardt 1985). In other words, both parties in agency relationship know what the agent has done. But the information between principal and agent is not always complete, there is information asymmetry between the cooperative parties (Li et al. 2010). In most instances, the agents know what they have done while the principals are not. On this occasion, a deviation arises because the principal cannot determine if the agent has behaved appropriately (Shapiro 2005). To avoid such deviation, some principals would purchase the information about their agents' behaviors (Eisenhardt 1985). That is to say principal would purchase additional layers of management to keep track with agent. This method can partially help principal to obtain information about agent's behavior with a relative high cost.
- Risk sharing arises when the principal and agent have different attitudes towards risk (Eisenhardt 1989). But in the context of hospital, risk is mainly born by the principal physicians and it is less likely to be passed to the agent physicians through the indirect system use. Therefore, we won't take risk sharing into account in this study.

To overcome above agency problems and govern the relationship between principal and agent, two different control strategies based on evaluation methods were proposed as followed: (a) *behavior-oriented control mechanism* and (b) *outcome-oriented control mechanism* (Eisenhardt 1985). In behavior-oriented relationship, the principal evaluates the agent's behavior by monitoring and directing

[1] In this study, we use the words contract, control mechanism and control strategy exchangeable.

his/her behavior (Herath and Rao 2009). It doesn't mean the principal will monitor the agent's behavior all the time. In outcome-oriented relationship, the principal verifies what the agent has done through checking the task outcome (Anderson and Oliver 1987). The principal can ensure the agent's behavior meets his expectation by focusing on agent's outcome or behavior as well as reconcile their desires and goals (Celly and Frazier 1996).

In organizational control research, the behavior- and outcome-oriented control mechanisms are also used to govern intra-organization and inter-organization relationship (Li et al. 2010; Ouchi William 1979), which can be regarded as principal-agent relationship as well. Meanwhile, these two control strategies are valid when individual principal delegates tasks to individual agent (Bergen et al. 1992). Rely on these two control mechanisms, the individual principal can monitor, direct and evaluate what the agent has done (Anderson and Oliver 1987), which can decrease the adverse impact of goal conflict and information asymmetry.

As mentioned before, in the context of hospital, principal physicians will also employ these two different control mechanisms to verify what the agent principals have done. Thus, we have valid reasons to anchor on agency theory to explore the effect of indirect system use in hospital.

3.1.1 Behavior-oriented control

With behavior-oriented control, the principal evaluates the agent's performance by monitoring his/her activities and operations with IS (Eisenhardt 1985). It implies that the agent's behavior should follow certain criteria and norms, which can suppress opportunistic behaviors to some degree (Li et al. 2010). Another advantage of behavior-oriented control is to help the principal to establish a fully understand of the agent's capability (Anderson and Oliver 1987). In addition, monitoring the agent's activities with IS, the principal can direct the agent's behavior (Oliver and Anderson 1994), and even help to cultivate the agent's skill on treatment. Further, the agent's capability will be improved.

Although the behavior-oriented control can help the principal to handle the relationship with agent, there are still some disadvantages of this kind control mechanism. First, it takes more time to monitor the process of agent's behavior than just to verify the agent's outcome (Jaworski 1988). For another, the principal need to build some criteria and norms to measure agent's actions (Anderson and Oliver 1987). The establishment of these criteria and norms is based on long-term cooperation (Fudenberg et al. 1990). Besides, the process of building the criteria and norms is not only subjective but also complex. Therefore, for those physicians who want to decrease heavy workloads through delegating HIS-related tasks to assistants, behavior-oriented control seems not improve efficiency as their expectation.

3.1.2 Outcome-oriented control

As the name suggested, outcome-oriented control mechanism focuses on the agent's operation outcome with IS rather than the process of accomplish the tasks (Eisenhardt 1985). It is more convenient for the principal to check the outcome comparing to monitor behavior. On the other hand, such control mechanism arouses the enthusiasm of the agent since outcome-oriented control gives the agent a chance to use his/her own knowledge and method to perform tasks (Ouchi and Maguire 1975). Allowing the agent to apply what he/she has learnt from medical school to practice and to hold the responsibility for the outcome his/herself (Anderson and Oliver 1987) make him/her feel identified. But the outcome-oriented control in our circumstance cannot prevent the negative effects caused by incorrect behavior of the agent.

Here is a point should be given particular note. In salesforce control research, people tend to value outcome more than process (Anderson 2008). It partly because this research stream pursuits the maximize profit (Piercy et al. 1998), and also partly because the outcome is more intuitive and convenient to quantize (Kirsch et al. 2002). However, in hospital, the outcome is not as clear as in marketing. For example, if the principal physicians ask their assistants to help transcribe medical record, then the principal physicians have to verify the entire record. Even so, it still save a lot time and efforts, compared with doing such tasks by principal physicians themselves.

3.2 Task Complexity

User performance is associated with the characteristics of the task (Vakkari 1999). The effects of different control mechanisms will vary with the characteristics of task, especially the task complexity. The complexity of IS-related task plays a vital important role in determining the consequence of user-system interaction. Thus, we also explore the potential moderating effect of task complexity on the relationship between indirect system use and task performance.

Because this study focuses on the effects of different kinds of control mechanisms oriented indirect system use on task performance, during the process that principal physicians ask agent physicians to help them perform some HIS-related tasks, task programmability, outcome uncertainty and measurability are appropriate measurements of task complexity (Eisenhardt 1989). Task programmability in agency theory is the degree to which the task performed by the agent can be defined in advance (Govindarajan and Fisher 1990). If the task is more programmability, it is less complexity (Eisenhardt 1988). On one hand, it is easy for the principal to evaluate the agent's behavior if task has a high programmability (Shi et al. 2005). On the other hand, programmed task has specific path to restrict agent's action. For example, the task of writing medical record is much more programmed than prescribing across different patients. Obviously, it is much better to monitor the task of prescribing than verify its outcome for avoiding errors. According to Campbell (1988), the outcome uncertainty of task increases the complexity of task. When the outcome uncertainty is high, behavior-oriented control is more suitable than the outcome-oriented control in influencing agent's behavior (Eisenhardt 1989). Task measurability is another measurement of task complexity. Task measurability is the degree to which the performance of the task can be measured (Govindarajan and Fisher 1990). If a task need a long time to complete, its performance may be not only difficult to measure but also difficult to measure within a certain amount of time (Anderson 2008). When the task is less measurable, the complexity of task is higher because it need more information processing for the task.

3.3 Task Performance

HIS-related tasks are the healthcare activities that involving HIS and computers. The performance of healthcare activities can be evaluated in many ways, and no single measure can adequately operationalized task performance in healthcare setting. Table 3 lists some measurements used in previous studies. As can be seen from Table 3, these studies used almost similar measurements when observing healthcare activities within HIS. For example, Kane and Alavi (2008) strongly believed that successful task completion heavily reflected in efficiency of care, quality of care. They argued that if the healthcare organization can used IS appropriately, faster and better care can be achieved. Besides, patient care is also the intensive interactions between the patients and service personnel (Sykes et al. 2011). Thus, except for efficiency of care and quality of care, Kane and Labianca (2011) included the patient satisfaction in their study to have a comprehensive understand of HIS implementation performance. Venkatesh et al. (2011) also focused on quality of care and patient satisfaction based on prior study.

In this study, we aim to see the impact of indirect system use on principal physicians' HIS-related task performance. Although patient satisfaction can partially reflect indirect system use, efficiency of care and quality of care are more robust and objective for us to examine task performance under this setting. Therefore, we will follow Kane and Alavi's (2008) and Venkatesh et al.'s (2011) measurements when investigating principal physicians' task performance.

Source	Measurement	Description and operationalization
Kane and Labiance (2011)	Efficiency of care Quality of care Patient satisfaction	Efficiency of care: the average minutes a patient waited for an appointment. Quality of care: diabetes control. Patient satisfaction: ask a random sample of patients to rate their satisfaction.
Venkatesh et al. (2011)	Quality of care Patient satisfaction	Quality of care (formative constructs): technical quality, communication, interpersonal interactions, time spent. Patient satisfaction: rating from patients.
Sykes and Venkatesh (2011)	Patient satisfaction	Patient assessment.
Kane and Alavi (2008)	Efficiency of care Quality of care	Efficiency of care: the average patient waiting time. Quality of care: lab test result.
Luo and Ling (2013)	Effectiveness Productivity	Self-report perceived effectiveness, productivity and performance.
Luo et al. (2015)	Solution satisfaction Process satisfaction	Both satisfaction were measured with the average of individual perceptions of group attribute.

Table 3. Healthcare activities performance measurements

Efficiency of care is important because a key aspect for healthcare organization to deliver care is related to how quickly the organization can provide care (Kane and Labianca 2011). If a hospital can move patients through the process more rapidly, it can attend more patients, so hospitals were constantly evaluated on turnover rate of inpatients or timely treatment. In this study, efficiency of care captures the degree how fast the required healthcare tasks can be accomplished by the physician (Kane and Alavi 2008), which should be operationalized at the physician level in terms of the average length of stay of patients.

Quality of care is a little bit complex to recognize. Venkatesh et al. (2011) built a four key metrics of quality of care – i.e., technical quality, communication, interpersonal aspect, and time spent. But their study was concerned with the relationship between quality of care and patient satisfaction, in which communication and interpersonal aspect play great roles. Meanwhile, some researches in medical science deem the quality of case is reflected in survival rate or some laboratory testing (Chaudhry et al. 2006), both of which are associated with physician's capability of treatment to a great extent. This study focuses on physicians' successful task completion, which is more related to technical quality and time spent. And that time spent has been captured through efficiency of care. Therefore, to make it easy to capture quality of care in this study, we consider quality of care is associated with physician's technical skill (i.e., capability and skill of treatment). In other words, physician with better technical capability can provide better technical quality.

4 A CONCEPTUAL MODEL

Based on the phenomenon of indirect system use in hospital and agency theory, we propose a conceptual model to guide the examination of different control mechanisms oriented indirect system use. The model shown in Figure 1 contains the major constructs. It conceptually contributes to providing a control mechanism oriented indirect system use system from the principal's perspective. These major constructs are behavior-oriented indirect system use, outcome-oriented indirect system use, task complexity and task performance. And the relationship between these constructs integrated with this conceptual model will be discussed in the following sections. As mentioned before, efficiency of care and quality of care are the appropriate measurements for HIS-related activities performance. Following the studies of Kane and Labianca (2011) and Venkatesh et al. (2011), efficiency of care will be operationalized at the physician level in terms of the average length of stay of patients, and quality of care is captured from technical quality, which is associated with technical skill of physicians.

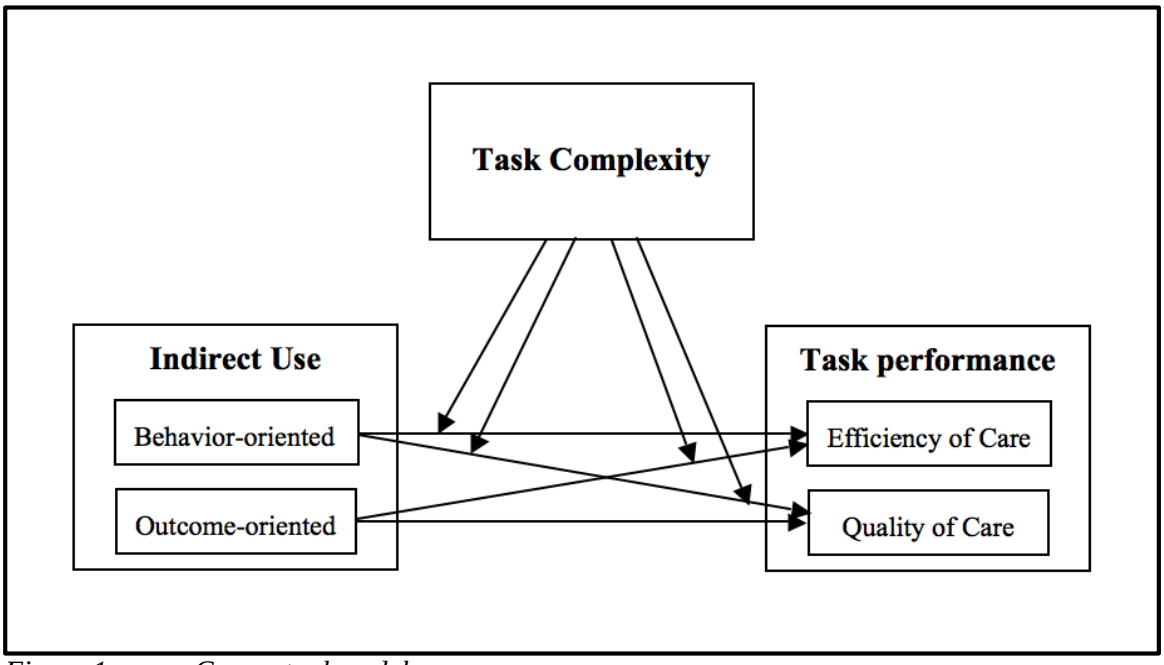

Figure 1. Conceptual model

4.1 Behavior-oriented Indirect system use and Outcome-oriented Indirect system use

We observed the phenomenon of indirect system use in the inpatient department of a major hospital. In this hospital, the principal physicians let their assistants to help them with some HIS-related tasks, but the cooperating two parties may have different goals and desires. The principal physicians seek to complete these HIS-related tasks quickly and effectively to improve their own work performance, while the agent physicians want to work at their own pace and obtain benefits. Moreover, the information about agent physicians' behaviors is not complete. These barriers impede the healthcare activities implementing in a proper and well-organized way.

To guarantee the performance of the HIS-related tasks, principal physicians employ different strategies to make their agents behave appropriate by monitoring the process or outcome of their behavior. For example, some principal physicians choose to verify the printed-paper of medical records (i.e., check the outcome), others choose to monitor the entry process now and then (i.e., monitor the behavior of agent), to make sure the data entry task has been done appropriately. It is obvious that the two different strategies used to control the agent's behavior in this hospital are behavior-oriented control and outcome-oriented control. Based on these two distinct control mechanisms, we can differentiate indirect system use as behavior-oriented indirect system use and outcome-oriented indirect system use.

According to agency theory, control mechanisms bridge the gap between the principal and the agent in terms of goal conflict and information asymmetry (Ouchi and Maguire 1975). Rooting in behavior-oriented control mechanism, behavior-oriented indirect system use aligns the agent physicians' actions through monitoring and directing the process that agent physician perform these HIS-related tasks (Lewicki and Sheppard 1985). While the outcome-oriented indirect system use makes the agent physicians behave appropriately through verifying the outcomes of these HIS-related tasks (Oliver and Anderson 1995).

These two kinds of indirect system use restrict the inappropriate behavior of agent physicians with HIS-related tasks by offering controls to principal physicians on agent physicians' actions, during indirect system use process. For one thing, control mechanisms decrease the goal conflict between the cooperative parties in agency relationship (Eisenhardt 1988), letting the agent physicians behave in the interest of the principal physicians. So the agent physicians will perform the HIS-related tasks as the principal physicians expecting (Ross 1973). In the second place, the principal physicians can correct their agents' action in time by monitoring the process or checking the outcomes of these HIS-related tasks (Anderson and Oliver 1987). In this way, opportunistic behaviors of the agent physicians are less

likely to occur (Li et al. 2010), making the HIS-related task be fulfilled in a quick and effective way. Both the behavior- and outcome-oriented indirect system use can decrease the deviation between agent physicians' actions and principal physicians' expectations, which can lead to a better performance in both efficiency and quality of care than indirect system use without any control mechanisms. Specifically,

Proposition 1: Behavior-oriented indirect system use is positively associated to HIS-related task performance in

(a) efficiency of care.

(b) quality of care.

Proposition 2: Outcome-oriented indirect system use is positively associated to HIS-related task performance in

(a) efficiency of care.

(b) quality of care.

Researchers have suggested that behavior-oriented indirect system use not only minimizes agent's opportunism, but also offer direction and guidance to agent's behavior, compared to outcome-oriented indirect system use (Anderson and Oliver 1987; Celly and Frazier 1996; Cravens et al. 1993). Through practicing with HIS, together with principal physicians' guidance and direction, the treatment skill and medical knowledge of the agent physicians will be improved (Cranton 1994). Cravens et al. (1993) suggested that the more a control system is behavior-oriented, the more domain knowledge and integrated expertise the agent physicians will have. Then the agent physicians will be more professionally competent, which can finally contribute to the quality of the HIS-related tasks that performed by the agent physicians.

At the same time, the monitoring and directing in behavior-oriented indirect system use cost the principal and agent physicians more time than those under outcome-oriented indirect system use. The principal physicians needs spending times to guide agent physicians, which has a negative effect on efficiency of care. For another, outcome-oriented indirect system use concentrates on the agent physicians' operation outcomes with HIS-related tasks rather than the process of accomplishing these tasks (Eisenhardt 1985). So the outcome-oriented indirect system use is more efficient than behavior-oriented indirect system use. Hence, we propose:

Proposition 3: Compared with outcome-oriented indirect, behavior-oriented indirect system use has better quality of care.

Proposition 4: Compared with behavior-oriented indirect, outcome-oriented indirect system use has better efficiency of care.

4.2 Task Complexity

As mentioned above, the effects of different control mechanisms vary with the task complexity; therefore, the behavior- and outcome-oriented indirect system use may perform diversely at different levels of task. Obviously, as task complexity increasing, more time and efforts are needed to complete tasks. Anchor on agency theory, we identify three main features associating with task complexity in the context of indirect system use in hospital. They are task programmability, outcome uncertainty and task measurability.

Task programmability and task measurability are inversely linked to task complexity (Eisenhardt 1985). And the outcome uncertainty is positively related to task complexity (Campbell 1988). Thus, tasks with high complexity are less programmed, and meanwhile the outcome is uncertain and not easy to measure. In the illustration of Ouchi William (1979), the underlying linkage between task characteristics and control strategies is simple. Eisenhardt (1989) argued that programmability and outcome uncertainty are positively associated with behavior-oriented control, while task measurability is negatively associated with behavior-oriented control. Conversely, task programmability and outcome uncertainty are negatively associated with outcome-oriented control, and task measurability is positively associated with outcome-oriented control. Both the behavior- and the outcome-oriented indirect system use aim at minimizing the impact of goal incongruence during principal physicians' indirect interacting with HIS.

Since the effects of different control mechanisms vary with the task characteristics, task complexity may change the effects of indirect system use on task performance.

In the formulation of Wood (1986) about task complexity, complex tasks contain much more information than simple tasks, involving a higher cognitive load that requires significant attention and mental effort. As a result, the cognitive processing shifts from receiving tasks to actual action takes the agent physicians more time and efforts (Speier and Morris 2003). For the control strategy using behavior as the basis, the principal physicians will give direction about how to do these tasks (Cravens et al. 1993), which not only saves the time of implementing task, but also directs the agent physicians to gain medical knowledge. In this way, the agent physicians get great upgrade in the technical treatment skill. For example, let us look at the task writing medical record and the task performing e-prescribing for certain patient. Obviously, the latter one is more complexity since the prescription should be made based on individual patient's context and experience. Guidance and monitoring from the principal physicians can direct the agent physicians behave efficiently and effectively, ensuring patient get treatment in time and avoiding making mistakes.

On the contrary, as for the simple task including less information processing, the goal is clearly stated and the procedure is explicitly specified (Byström and Järvelin 1995). The agent physicians commonly knows how to perform it in an efficient and effective way. Monitoring the process of agent physicians' behaviors is redundant, which is a little bit waste behavior-oriented control's advantages. Therefore, outcome-orient control is more suitable for the simple task since it can save the time for both the principal physicians and agent physicians. For example, the task of writing medical record, which is more programmed and measurable than performing e-prescribing, will be implemented more quickly under the outcome-oriented indirect system use setting. Meanwhile, outcome-oriented control makes the agent physicians free rein and feel be trusted, arousing their enthusiasm to work (Anderson and Oliver 1987). That is, the agent physicians will try their best to accomplish the HIS-related tasks, which may lead to a better performance in quality of care as well. Therefore,

Proposition 5: The greater the HIS-related task complexity, the greater the positive impact of behavior-oriented indirect system use to HIS-related task performance on

(a) efficiency of care.

(b) quality of care.

Proposition 6: The less the HIS-related task complexity, the greater the positive impact of outcome-oriented indirect system use to HIS-related task performance on

(a) efficiency of care.

(b) quality of care.

5 CONCLUSION

This study is one of the early attempts to theoretically study the impacts of different control mechanisms oriented indirect system use on task performance in view of task complexity in hospital. Understanding indirect system use is of paramount importance for us to have a comprehensive view about IS usage. This study has implications for both the theory and practice through examining the effects of behavior- and outcome-oriented indirect system use in hospital.

Theoretically, this study first hopes to advance the current understanding of indirect system use in terms of control mechanisms governing the cooperative parties. Prior studies adopting the IS centrality to capture indirect system use ignored the goal conflict and information asymmetry between the principal and the agent during indirect system use. This study categorizes indirect system use into behavior- and outcome-oriented cases based on agency theory, providing us a new angle to examine indirect system use. Secondly, based on such taxonomy, this study presents the advantages and disadvantages of the different control mechanisms oriented indirect system use and further demonstrates their different impacts on task performance on the basis of efficiency and quality of care. By differentiating the impacts of behavior- and outcome-oriented indirect system use, this study aims to supplement agency literature. Additionally, this study identifies the moderate effects of task complexity on the relationship between indirect system use and task performance. Since complex task contains much more information than

simple task, behavior- and outcome-oriented indirect system use may perform diversely at different levels of task complexity. By integrating task complexity, we would be able to have a full understanding about indirect system use and its performance.

The phenomenon of indirect system use is widespread. This study also offers critical implications for practitioners. Incorporating different control mechanisms with indirect system use, principals can align agents' behavior to realize their objectives. Therefore, principals can (e.g., the senior physicians) enjoy a better performance in efficiency and quality of the IS-related tasks through choosing an appropriate mechanism to govern indirect system use. In addition, a better understanding of indirect system use with different control mechanisms can help both the principal and agent to make a long-term plan. In sum, our study provides valuable knowledge to practitioners to implement indirect system use.

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