

Information Systems and Social Networks in Healthcare Delivery Performance

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Introduction

Information systems (IS) can be used as valuable tools to support organizational work in knowledge-intensive settings, including healthcare delivery environments. IS enable individuals to store and access vast amounts of codified knowledge, to search and retrieve that knowledge, to combine and create new knowledge, and to apply that knowledge to organizational problems in new ways (Alavi and Leidner 2001). IS research has recognized, however, that the mere presence of IS in an organization is not sufficient to influence performance outcomes. Whether and how people actually interact with the IS at their disposal is a critical factor for understanding their influence in organizations (DeLone and McLean 1992; Devaraj and Kohli 2003).

Researchers have traditionally studied the ways in which individuals' own use of information systems affect performance outcomes, but this conceptualization of direct user-system interaction does not illuminate the many forms of indirect impacts these technologies may have. Healthcare organizations increasingly rely on teams of employees comprised of multiple individuals to work together on organizational tasks, and these groups typically depend on more than one information system to support their work. Thus, whereas most IS research continues to conceptualize user-system interactions as a *dyad* (a single user interacting with a single information system) most organizations actually function as a *network* (multiple users interacting with multiple information systems). Understanding how user-system interactions influence group-level performance outcomes in a networked setting of multiple people and multiple information systems is a non-trivial problem. On one hand, the answer may be simple. Group-level interactions between multiple people and multiple information systems may be an aggregation of the dyadic user-system interactions traditionally examined in IS research. On the other hand, the answer might not be so simple. Multiple people interacting with each other and with multiple information systems could result in complex structures of interpersonal and user-system interactions. These network structures may be important for producing a more complete understanding of the impact of IS on organizational outcomes.

Research Setting and Method

Our research was conducted in a regional division of a national health maintenance organization (HMO), pseudonymously referred to as HealthProviders. We first performed 18 months of qualitative analysis of the organization, interviewing employees, attending system-related meetings, and direct observation of healthcare teams. We then administered a survey to 614 members of 40 primary care groups in the regional division of a large, national HMO. Although HealthProviders has developed a robust IS infrastructure to support groups in providing effective healthcare, their ability to provide effective care relies heavily on the ability of group members to interact effectively with each other and with this IS infrastructure. These groups share a number of features that make it an attractive setting to study the effects of multimodal networks. Despite the commonalities between these groups, anecdotal evidence suggested that groups interacted with the IS very differently, resulting in different multimodal network structures. This setting provides us the ability to control for many network (group) factors and isolate the effects of the different multimodal network structures on organizational performance outcomes. Outcomes are measured in terms of 1) patient wait time 2) patient satisfaction 3) quality of care 4) chronic care.

Findings

We investigated three aspects of these multimodal networks to determine whether and how the information systems influenced the group's performance – the mechanism by which system use influenced performance, the impact of system avoidance on performance, and the distribution of IS proficiency with the group.

Individual vs. Collective Use. First, we examine how the healthcare group as a whole interacted with the information systems to provide care, investigating two different possible mechanisms. First, we test whether the impact of an information system on organizational performance outcomes is a function of direct *individual use*. We aggregate the strength of all the dyadic user-system interactions in a group to assess its relationship to a group's performance outcomes. Second, we test whether the impact of an information system on organizational performance outcomes is also related to its *collective use*, the network of interpersonal interactions that mediate information transfer between information systems and all members of the group, users and non-users alike. We draw upon social network analysis to assess the relational structures associated with indirect use in terms of the information system's centrality in the group's social network.

We find that the centrality of the IS within the network is significantly related to organizational performance outcomes, but the simple aggregation of dyadic user-system interactions is not. The impact of information systems on organizational performance outcomes in a multi-user, multi-system group, therefore, is more complex than simply the sum of direct user-system interactions that comprise it. It depends instead on the network structures that emerge when the user-user and user-system relationships are integrated as a whole network. These findings suggest that researchers should move away from an exclusively dyadic conceptualization of direct user-system interactions and begin to explore the interplay between digital and social networks. The impact of information systems on healthcare outcomes, therefore, depends not on how healthcare providers use the systems personally but on how they use them as a group.

Avoiding the Systems. Researchers have identified resistance to be particularly problematic in healthcare settings (Hendy et al. 2005; Timmons 2003). Information systems are supposed to positively influence healthcare efficiency and quality, but these goals are likely to be thwarted if healthcare workers avoid using the systems (Chau and Hu 2001). We adopt the term *IS avoidance* – an individual's preference to avoid working with an information system despite the need and opportunity to do so – to describe a specific type of post-adoption resistance. This term implies that the individual has the opportunity and even the need, but consciously circumvents using the system. We investigate whether and how IS avoidance influences the performance of healthcare groups in terms of efficiency and quality of care. We do so across three levels of analysis: the individual doctor level (i.e. whether a patient's primary doctor avoids the system), the group level (the total number of team members who avoid the system), and the network level (the centrality of the people who avoid the system).

Our results indicate that IS avoidance is consistently and negatively associated with each of these measures of performance – but *only* at the configural group level. We use our qualitative data to better understand our somewhat unexpected findings. Our analysis in this phase suggests that IS

avoidance can disproportionately affect performance but that groups can rely on complex network structures to compensate for the IS avoidance at the individual and shared group levels. These structures cannot, however, mitigate the effect of IS avoidance at the configural group level.

Centrality-Proficiency Alignment. End-user proficiency is a key factor in determining how effectively organizations can leverage information systems (IS) to influence organizational performance outcomes (Nelson 1991; Santhanam and Sein 1994). Users who are more proficient with IS will use those systems to work more effectively and efficiently than users who are less proficient (Marcolin et al. 2000). Organizations spend considerable time and money improving the IS proficiency of end users through training, so IS researchers have spent much energy and effort discovering more effective training methods (Nelson and Cheney 1987). Most existing research on IS proficiency has been conducted at the individual level, addressing how well a given user interacts with IS to conduct individual-level tasks. Recent research has suggested that IS researchers should move beyond examining the user-system relationship at the individual level to consider the impact of user-systems interactions at the group level (Burton-Jones and Gallivan 2007). How IS proficiency operates at the group level is inadequately understood, so it is an important question facing IS researchers and practitioners.

We use concepts from social network analysis (SNA) to characterize how IS proficiency is distributed in a group. SNA is a research paradigm that studies the configuration of nodes and network ties (Borgatti et al. 2009; Kilduff et al. 2006). We argue that a group's performance is impacted not only by the average level of IS proficiency but also by its distribution relative to centrality. That is, a group enjoys greater benefits if its more proficient members are highly central. As such, we argue that the alignment between IS proficiency and users' centrality in the group is likely to be positively related to performance at the group level. We introduce a measure called *centrality-proficiency alignment* (CP-Alignment) to measure the centrality of the group's most proficient users. We find that CP-Alignment is positively related to a group's performance, controlling for overall levels of IS proficiency in a group. We further find that this central alignment is highly dependent on task type, with more interdependent tasks requiring greater alignment. We also find evidence that lower overall levels of proficiency are necessary in centrally aligned groups.

Conclusion

Taken together, these studies suggest that information systems are most effective for healthcare outcomes when they are integrated into the social and communication networks of the group. Repeated evidence shows that individual use of the system does not have as significant of an influence on performance as does how these systems are integrated into the group. Implications are that these social network factors should be considered when implementing and using information systems to provide healthcare.

References

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