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Temporal Implications of Information Technology for Work Practices: Organizing in and for Time in an Emergency Department

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Abstract
We investigate the temporal implications of information technology by examining its use in the work practices of physicians and nurses in an emergency department. We conceptualize the temporality in work practices being constituted by temporal enactment (e.g., linearity), temporal construal (e.g., autonomy), and temporal spatiality (e.g., regionalization). By using this categorization we found that information technology impinges on temporal organizing by imposing its specific temporal logics and by being location dependent. Distinct information technologies have different impacts on temporality in work, and temporal effects of the same information technology vary across work groups. This highlights the need for alternative technological configurations to support varying temporal practices. The findings underscore the potential of information technology as a temporal boundary object that reconciles differences in temporal organization among work groups.

Keywords: Information Technology, Temporality, Temporal Organizing, Work Practices, Work Groups

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Introduction

Information technology, intricately bound up with time in terms of time-space convergence and time-space distanciation (Giddens 1984) affects temporality of work (Lee and Whitley 2002). A review of the current literature, however, reveals that research on temporal impacts of information technology on organizational work is scant in number and limited in scope. There are handful empirical studies on the temporal aspect of work enabled and/or mediated by information technology (e.g., Maznevski and Chudoba 2001; Sarker and Sahay 2004; Yoo and Alavi 2004), on temporal coordination mechanisms, such as allocating, scheduling and synchronizing, used by distributed groups that interact through information technology medium to accomplish a task (e.g., Bardram 2000; Massey et al 2003), and on changes in temporal organization of work induced by information technology in workplace (e.g., Barley 1988; Lee and Liebenau 2000). While these studies have examined how information technology affects the temporal structure of daily events and the temporal characteristics of tasks, they remain silent on the impacts of information technology on how organizational members deal with temporal dimension of tasks and events. In brief, efforts to investigate the temporal organizing with and by information technology have been few in the extant literature.

The purpose of this paper is to investigate the interplay between the temporal organizing and the use of information technology. We do so by examining the use of a range of information technology artifacts in work practice. In this paper, work practices refer to "the practices through which participants organize their work in the face of contingencies that unfold as part of the working day" (Button and Harper 1996; p. 271). This definition characterizes work practices not as the formal specifications of work, but as the real-time phenomena - the details of how work is organized through practical organizational conducts and interactions. Information technology here is interpreted broadly to cover any digital technology that enables storage, transmission and manipulation of digital information.

We conceptualize that temporality in work practices has both structural and interpretive "being". It has both external attributes as reflected in people's temporal behavior that can be measured by objective time-measuring devices, and internal attributes as manifested in people's perception and orientation to time. In addition, we further argue that time is inseparable from space and that temporality in work practices is intertwined with the spatiality in work places.

Guided by such conceptualization, we conduct a field study of physicians and nurses in an emergency department at a university hospital. We found that information technology impinges on temporal organizing by imposing its own specific temporal logics and by being location dependent. Our analyses show that distinct information technologies have different effects on temporal organizing and that the temporal impacts of the same information technology vary across work groups. Our findings highlight the need for alternative technological configurations to support different temporal practices, and underscore the potential of information technology as a temporal boundary object in reconciling differences in temporal organization.

The rest of our paper is organized as follows. In the next section, we present the conceptualization of temporality in work practices and raise our research question. Thereafter, we provide a description of our research site, data collection and analysis. This is followed by the discussions of findings and implications of the case study. Finally, we conclude the paper with the contributions and limitations of our study.

Conceptualization of Temporality in Work Practices

Work practices take places within certain temporal boundaries, and temporal organizing is at the heart of work practices. Previous research (e.g., Barly 1988; Dubinskas 1988; Gersick 1988; Lawrence and Lorsch 1967; McGrath 1991; Zerubavel 1979) has studied temporality in work practices in terms of, but not limited to, sequence, temporal location, duration, pace, deadline, rhythm, temporal orientation, and temporal horizon. These temporal attributes can be grouped into two distinct dimensions: temporal enactment and temporal construal (Ballard and Seibold 2003).

Temporal enactment refers to the way people perform time through regularized patterns of behavior, as reflected in such attributes as duration, sequence, pace, and rhythm that can be captured by objective time-measuring devices (e.g., uniform seconds, minutes and hours that clocks measure). *Temporal construal* refers to the way people experience or orient to time as manifested in temporal parameters such as temporal horizon (long vs. short term), temporal orientation (past, present and future), and experience of time as scarce, dull, slow, and urgent. Temporal enactment emphasizes the objective and quantitative features of time, and temporal construal stresses the subjective and qualitative aspect of time in work practices.

In addition, we argue that time and space is inseparable in work practices, as a movement in space is inherently a movement in time (Carlstein 1982) and no two objects can be at the same time point in two different spaces in the physical world (Giddens 1984). We treat the intertwined nature of time and space as the third aspect of temporality in work practices – *temporal spatiality*, and define it as the way people spend time through their actions and motions in the space around them.

To summarize, temporality in work practice is constituted by temporal enactment, temporal construal and temporal spatiality. Such conceptualization of temporality offers us an analytical lens to address our research question: how does the use of information technology affect the temporal organizing of work?

Method

Case Study

A case study was conducted to answer our research question. The case study research method is found appropriate for at least two reasons. First, case research is particularly useful for practice-based issues where the experiences of the actors are important and the context of action is critical (Benbasat et al., 1987). Our focus is on work practices, which are always time-space specific, and an idiographic case study is necessary to understand the phenomenon in context. Second, case research is a preferred research strategy to answer "how?" and "why?" questions (Yin, 1994). We are interested in a "how"- type research question, and a descriptive case study can offer rich insights into temporality in work practices.

Research Site

The research site, the emergency department of a university hospital, is a leading emergency department located in an urban setting in the Mid-Western United States. It runs twenty four hours a day and seven days a week, and treats about 780,000 patients per year. The emergency department is temporally disorderly as patients with varying medical conditions come unpredictably. Four groups of medical staff – physicians, nurses, paramedics, and technicians – move constantly in the emergency department to respond to various demands of patient

treatment and care. Paramedics usually pair up with nurses as an assistant to them. A technician is essentially an errand runner, engaging in work where he/she is needed. Physicians and nurses stand in the center of patient treatment and care. They are of particular interest to our study because they are the primary information technology users in the emergency department.

We chose the emergency department for at least two important reasons. First, because emergency medicine is time critical and its practitioners are time sensitive, the emergency department presents itself an opportunity to examine temporal enactment and temporal construal. Second, constant movements of medical staff in the emergency department allow us to study the temporal spatiality in work practices.

Data Collection

Direct observations and informal interviews are the two primary data sources. The first author observed the emergency department treatment processes intensively and shadowed medical staff with a particular emphasis on the use of information technology in their work. In total, she spent forty hours on observing the emergency department operations and thirty hours on shadowing physicians and nurses. These observations were complemented with informal interviews, in which physicians and nurses' own explanations and opinions of why they did their work as observed were sought.

To systemize the observational data and improve their reliability, we kept separate sets of notes as recommended by Silverman (2001). The first author took short notes in the field. After each field session, she expanded these notes made in the field by including additional information such as how the field notes were recorded and in what context. In addition, she met with the other two authors to discuss issues and ideas that arose in each field trip with them as a sounding board. New theoretical ideas emerged from those sessions were then tested against the existing data and guided further data collection.

The medical staff confirmed that the presence of the first author in the emergency department did not affect their work practices (i.e., no the Hawthorne effect) because they are used to non-emergency department personnel's constant moving into and out of the emergency department. Our expanded field notes, when shown to the physicians and nurses, were considered by them accurate representations of their work practices.

In addition, the first author gathered treatment-related documents and all the three authors had several meetings with key personnel (e.g., the emergency department director, the head nurse, and the charge nurses) and learned some useful second-hand information about the use of information technology in the emergency department. The use of multiple sources of data collection provides multiple perspectives and more information on temporal organizing in the emergency department.

Data Analysis

A multi-step analysis process was used in data analysis. We first read the field notes several times to become immersed in the data, which is a critical step in the analysis process (Eisendardt 1989). Reading the observational and informal interview data repeatedly allows us to capture the work practices of physicians and nurses and to identify a medical information system and the mobile phone as the two major information technologies used in the emergency department.

Based on our categorization of temporality in work practices, we further identified four temporal attributes from the data that characterize temporal enactment, temporal construal and temporal spatiality in the use of the medical information system and mobile phones. They are linearity (Ballard and Seibold 2003), entrainment (Ancona and Chong 1996), autonomy

(Schriber and Gutek 1987), and regionalization (Giddens 1984), as shown in Table 1. Linearity and entrainment are the two temporal attributes associated with temporal enactment. The former refers to the linear or non-linear mode of task execution, and the latter to the adjustment of activities to match with external events. Autonomy, a temporal attribute related to temporal construal, is defined as the perceived control over the use of one's time. Regionalization, the zoning of time-space in relation to routinized work practices, deals with temporal spatiality in work practices. These temporal attributes are theoretically and conceptually distinct, though not necessarily orthogonal, and each represents a unique aspect of temporal enactment, temporal construal and temporal spatiality found in the literature and judged by us to figure differently in temporal practices of physicians and nurses.

Dimensions	Definition
Temporal Enactment	The way people perform time through regularized patterns of behavior
Linearity (e.g., Ballard and Seibold 2003)	The linear or non-linear mode of actual task execution
Entrainment (e.g., Ancona, and Chong 1996)	The adjustment of activities to match with external events
Temporal Construal	The way people experience or orient to time
Autonomy (e.g., Schriber and Gutek 1987)	The perceived control over the use of one's time
Spatial Temporality	The way people spend time through their actions and motions in the space around them
Regionalization (e.g., Giddens 1984)	The zoning of time-space in relation to routinized work practices

Table 1. Conceptualization of temporality in work practices

We then examined the field notes on the four temporal attributes for each type of information technology to see how the use of information technology affects temporal enactment, temporal construal and temporal spatiality. Finally, the findings from the field observations were triangulated with the data from documents and meetings.

Findings

Patient Treatment Process

Before we detail the effects of information technology on temporal organizing, we briefly present the patient treatment process and the use of physical artifacts in physicians and nurses' work.

Patient treatment process. Figure 1 illustrates the typical patient treatment process in the emergency department. After a patient comes to the ward, he/she is first greeted by a nurse. The nurse asks the patient some general questions, such as why he/she has visited the emergency department, whether he/she has any chronic disease or allergies. After the initial check-up, the nurse fills out the patient chart, puts it in the rack on the counter outside the nurse station for the next available physician to interview and examine the patient.

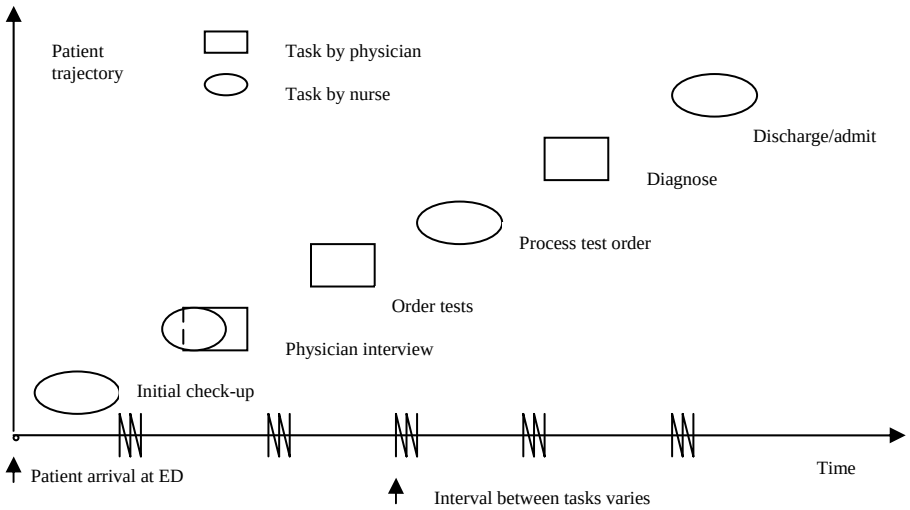

Figure 1: Patient treatment trajectory

The physician' first contacts with a patient take place in his/her interview with and examination of the patient in the ward usually with a nurse assisting. After the interview and examination, the physician orders some tests for diagnosis purpose. The nurse then draws samples from the patient, takes x-rays at the patient bedside, or moves the patient to the CT room to have a CT scans taken. When the results of lab tests, x-rays and CT scans are back from the specialized departments (e.g., the lab, the radiology department), the physician uses these data to make a diagnosis. Additional interviews will be conducted and more test orders will be added if the physician finds that the information at hand is insufficient. The physician may call up medical experts in specialized departments (e.g., psychiatrist, radiologist) for consultation, and the patient's private doctor for more patient information. Finally, depending on physicians' decisions of admission or discharge, the nurse either transmits the patient to specialized departments upstairs or sends the patient home.

In short, physicians and nurses engage in different activities at different temporal locations in a patient treatment process. The typical activities of physicians are interviewing and examining patients, ordering lab tests, examining medical information (e.g., lab results, x-rays), consulting outside expertise, making admission or discharge decisions, and dictating. In addition, physicians frequently go to the nurse station to take patient charts for treatment purposes and return them back for nurses' uses, to the white board to check patient statuses and update patient information, and to the information desk to drop discharge or admission forms and to ask the secretary at the desk to contact patients' private physicians.

Nurses do initial patient checking-up, assist physicians in their interviews with and examinations of patients, process test orders, administer medication, and transmit admitted patients to other departments. They also attend to patient clinical needs (e.g., pain, discomfort, fear) and non-clinical requests (e.g., clean sheets, extra sheets, going to restroom) and talk to patients' family members. Last but not least, they perform record-keeping activities such as taking nurse notes, updating the white board, sorting out print-outs of lab orders and lab test results and placing them in appropriate slots.

As physicians and nurses handle several different patients during the same time span, they switch between different activities with different patients to manage competing demands

imposed upon them. As a result, the various activities performed by physicians and nurses on different patients are dynamically intertwined. This is evident in our numerous observations that, while waiting for the test results of a patient, physicians start interviewing a new patient, examine test results and make a diagnosis for another patient. Similarly, nurses were observed to assist a physician's interview and examination of one patient, and draw the blood sample from another patient a moment later.

Use of physical artifacts. In their work, physicians and nurses interact with many physical artifacts. Our observations show that physicians refer to patient charts in interviewing and diagnosing, rely on the medical information system to order tests and review test results, use both regularly phones and mobile phones to communicate with outside experts and private physicians, and look at the white board for patient statuses. Similarly, we also found that nurses work on patient charts in their initial check-ups, deal with patient labels and test order print-outs when handling test orders, look at the white board for treatment updates, and check the medical information system for medical data. These physical artifacts, rudimentary or sophisticated, structure and assist in task completion, shaping and being shaped by on-going work practices.

As the outputs of nurses' activities become the inputs of physicians', and vice versa, physicians and nurses are reciprocally interdependent (Thompson 1967) and new information produced during their actions need be transmitted to each other. Such information is critical in the sense that the patient treatment process will stagnate if it is not exchanged between physicians and nurses in a reasonably timely manner. Four pieces of the critical information, as we identified, are (1) the waiting of a new patient, (2) the need of the nurse's assistance in interviews and examinations, (3) the order of tests, and (4) the admission/discharge decision.

Physical artifacts, such as the patient chart, the white board, and the medical information system, play an important role in conveying the critical information mentioned above. For example, when a nurse finishes the initial check-up on a patient, he/she places the patient chart in the rack on the counter outside the nurse station. The waiting patient chart sends physicians the critical information (1) that the preparatory work is done and the patient is ready for examination. After a physician orders a test via the medical information system, he/she places a "Lab-Order" magnet on the white board and the medical information system automatically generates a test order print-out in the nurse station. Through the magnet and the order print-out, the physician notifies nurses of the critical information (3) that a test order is placed.

Of these various physical artifacts in the emergency department, we are particularly interested in information technologies: medical information system and mobile phone - the two primary information technologies- used by physicians and nurses in their work. Studies of non-digital physical artifacts, such as patient chart, white board and paper form, can be found in Mackay (1999), and Xiao et al (2001). In the following two sub-sections, we elaborate on the use of the medical information system and mobile phones in the temporal practices of physicians and nurses.

Medical Information System

Both physicians and nurses use a same medical information system, but for different purposes and in different manners. In this section, we analyze the impacts of the medical information system on physicians and nurses' temporal organizing in terms of regionalization and entrainment.

Regionalization. Physicians use the system to order tests and review test results for diagnosis purpose. They can only access the system in the physicians' cubicle area. Dependent

on a fixed location for the computers, physicians constantly go back to the physicians' cubicle area to perform the two primary tasks of their work. As a result, physicians spend a large portion of their working time in their cubicle area on ordering tests and reviewing test results. Thus, physicians' activities of ordering tests and reviewing test results are temporally differentiated into the specific locale of the physicians' cubicle area where the medical information system is accessible.

The temporal and spatial structuring of physicians' activities resulted from the location dependency (Lyytinen and Yoo 2002) inherent in the desktop-based medical information system leads physicians to associate their cubicle area with the time spent on ordering tests and reviewing test results. Such regionalization affects the visibility of the work of physicians to patients in the emergency department.

The physicians' cubicle area is a small closed area out of sight of patient wards, the nurse station, the secretary desk, the white board, and other functional areas in the emergency department. This spatial closure provides a physical protection from extraneous factors and affords physicians a time of their own. Except for interviews and examinations, physicians have very limited direct contact with patients and work primarily in their cubicle area. Patients, confined in patient wards, have no clue of what is going on in the physicians' cubicle area. Accordingly, from patients' point of view, physicians are not always physically present sharing space with them in patient wards, and, therefore, perceived to be unavailable most of the time. In this sense, the physicians' cubicle area is a backstage region (Giddens 1984) with limited accessibility.

The invisibility of physicians' work due to the fact that physicians spend most working hours in the back region is evidenced in the comment, made by the chair of the emergency department in one of the meetings with us, that "[P]hysicians usually stay with patients for a very short period of time, say five minutes, in most cases, at the very beginning of patients' stay in the emergency department, and then they are gone. Patients feel that physicians spend only five minutes on them although physicians, in fact, work on them much longer. Imagine what patients feel if physicians order tests, review test results and make diagnoses right in front of them in the patient wards. I am sure they will feel much satisfied."

Nurses use the medical information system for the medical data of the patients who has visited the emergency department before. Like physicians, nurses can access the system only at a fixed location, i.e., in the nurse station. Similarly, the temporal experience of nurses also exhibits the time-space regionalization. But this regionalization does not change the visibility of nurses' work, because nurses spend a relatively much smaller amount of their total work time on searching patient medical information via the medical information system. In short, although the use of the medical information system temporally structures physicians and nurses' activities into specific locales, such regionalization differs in its impact on visibility of work.

Entrainment. The medical information system, as mentioned briefly in the section 4.1, plays a significant role at the third critical point when test orders are placed by physicians. After the interviews and examinations in patient wards, physicians and nurses go back to their own individual work again. Physicians return to their cubicles and make test orders, and the medical information system automatically prints out lab-order sheets in the nurse station.

Nurses anticipate test orders while engaging in other activities. They habitually go back to the nurse station and check test order print-outs. Once they have test orders, nurses give priority to and allocate time for the task of processing test orders. Several nurses we followed made comments similar to that "lab tests are critical for doctors to diagnose, and they are one of the factors that determine how long a patient will stay in the emergency department". As nurses

adjust their activities to the behavior of the medical information system, we observed an entrainment (Ancona and Chong 1996) of nurses to the medical information system.

Mobile Phone

Physicians carry mobile phones and use them primarily to communicate with experts from the specialized departments and patients' private physicians. The use of mobile phones enables physicians to communicate anytime and anywhere, synchronizes their activities to the ringing of mobile phones, challenges their linear mode of task execution, and impinges on their sense of temporal autonomy.

Regionalization. The use of mobile phones enables physicians to reach and be reachable regardless of where they are, and free them from their reliance on their cubicle area, where telephones are located, for communication with other medical personnel. Such anytime and anywhere accessibility makes communication easier, as reflected in one comment made by one physician that "It [the mobile phone] is convenient. With it, I will not miss a call because I am not in my cubicle. And I don't have to return to my cubicle when I need to make a call." Subsequently, we observed that physicians place and receive calls from their mobile phones literally everywhere they stay, in their cubicle, in front of the white board and the secretary desk, in the nurse station, in the hallways, and in the patient wards.

Entrainment. As a real-time tool, mobile phones allow activities to be superimposed on one other during the same time-span. We observed many times that mobile phones ring in the middle of physicians' talking with nurses in the nurse station, updating patients' treatment information in front of the white board, examining patients in patient wards, and so forth. As mobile phones demand instant response, physicians cut short their interactions at hand and respond to the calls from their mobile phones. As physicians synchronize with the ringing of their mobile phones, they become entrained to their mobile phones.

Linearity. Physicians' major tasks (e.g., interviewing and examining, ordering tests, diagnosing) are complex in nature and require a great deal of concentration in completion. Because these tasks cannot be inter-meshed, physicians carry out their tasks in successive time frames, rather than engage in multiple tasks simultaneously. As a result, we observed that physicians do not juggle several tasks at once but focus one task a time. Although they do terminate the activities at hand in response to extremely urgent demands, physicians, as one physician put, "feel more comfortable to close one task before start another."

To physicians, mobile phone is convenient as well as interrupting, because "it [the mobile phone] may ring anytime and re-directs my attention to a new situation" as one physician expressed. The always-on connections with other medical personnel set physicians in a position to constantly switch activities in response to mobile phone calls, no matter whether they are ready or not. Therefore, the use of mobile phones challenges physicians' linear mode of task execution by making them to start a new activity without closing the activity at hand. Even though, physicians, when are in the middle of some tasks and unable to make themselves available, as we observed, hang up mobile phones and call back later when they are done with their tasks at hand.

Autonomy. Physicians constantly prioritize and schedule their activities according to their own perception and understanding of the situations that they face. We observed that physicians have a fair degree of discretion in when to start a new patient, how many patients to

have, and whether to take an acute or non-acute patient, based on their workloads. They can even un-take a patient as we observed on one occasion where a physician put the patient chart back to the rack because, in his own words "[T]his is not a simple case. I'd better focus on what I've already had." Our observations also show that physicians decide when to perform what activity on which patient, as confirmed by one physician who told us that "We [physicians] decide the order to treat patients contingent on the situations we have."

In short, except for some rare situations, such as a dramatic change of a patient's condition, in which physicians are called upon, physicians decide what to do next and allocate their working time accordingly. However, the use of mobile phones sets physicians in a position to switch immediately to new activities demanded by their communications over the mobile phones. Although physicians sometimes put the involvement imposed upon them by their mobile phone conversations on hold, they do exhibit entrainment of the ringing of their mobile phones which requires instant actions as well. As interactions with other medical personnel via mobile phones push some of physicians' activities, physicians' perceived control over their time is lessened.

Implications

Summarized in Table 2 are the effects of the medical information system and mobile phones on linearity, entrainment, autonomy, and regionalization. We discuss the implications of our findings in this section.

	Medical Information System		**Mobile Phone**
	Physicians	Nurses	Physicians
Linearity	No	No	*Yes*
Entrainment	No	*Yes*	*Yes*
Autonomy	No	No	*Yes*
Regionalization	*Yes*	*Yes*	*Yes*

Table 2. Temporal effects of information technology

Temporal logics

Our study supports that information technology has its own temporal logics (Horning et al 1999). It further shows that information technology renders its user to become entrained to its temporal logics. The entrainment affects temporal organizing in how information technology users interact with each other.

As shown in our analyses, mobile phones enable patients' private physicians and outside experts to reach anytime physicians who are in constant move. The use of mobile phones enhances the communication between organizational members in the emergency department. On the other hand, mobile phones demand physicians' instant responses regardless where they are and what they are doing. The physicians' days become more fragmented as the use of mobile phones demands more improvisations and quicker actions in their work.

The medical information system automatically prints out test order sheets in the nurse station after physicians place test orders in their cubicle area. Test order sheets are temporally

important in the interactions between physicians and nurses because orders nurses' actions by embodying a time-reckoning mechanism (Dubinskas 1988).

Location dependency

The location dependency of information technology regionalizes its users' time into specific areas where information technology is accessible. Physicians' dependency on the fixed location to use the medical information system temporally packs their activities in their cubicle area, and to a large extent, sets their work in the backstage. In addition, it makes physicians constantly move back to their cubicle area to access information and received service available through the medical information system.

While mobile phones used by physicians relax their dependency on fixed locations for verbal communication, ubiquitous computing (Lyytinen and Yoo 2002), if implemented in the emergency department, will enable them to access information and exchange data anywhere. Consequently, physicians will be able to perform order tests, review tests results and make diagnoses in front of patients in the patient wards. In this sense, ubiquitous computing has the potential to move physicians work to the front stage and increases the visibility of their work to patients. Moreover, time spent on numerous trips to physicians' cubicle area to access the medical information systems could be saved for more patient treatment activities.

Varying temporal effects

Whereas the use of mobile phone affects temporal enactment, temporal construal and temporal spatiality, the temporal impacts of the medical information systems are found only in temporal enactment and temporal spatiality. This finding suggests that the effects of information technology on temporal organizing are not uniform, but vary across information technologies. Such variations may be attributed to the differences of temporal logics and location dependency embedded in information technologies.

Moreover, our study reveals that the temporal effects of the same information technology vary across work groups. Both physicians and nurses depend on a fixed location to access the medical information system, but the effects of regionalization are different for physicians and nurses. This may be resulted from the combination of the different temporal commitments that physicians and nurses make to the activities performed via the medical information system, and the different spatial layouts of the work areas of the two work groups.

In addition, whereas physicians do not synchronize their activities to those of the medical information system, nurses do. This difference in temporal organizing may be attributed to the different associations and expectations that the medical information system gives rise to physicians and nurses. Physicians initiate the actions of test ordering through the medical information system, and nurses respond to physicians' actions of test ordering through the test order sheets generated by the medical information system. The varying temporal effects of information technology across work groups pose an important question as to how to make different technological configurations of information technology to support the temporal practices of different work groups.

It is also important to note that the consequences of the mobile phones are potentially contradictory for different temporal dimensions. For the location dependency, mobile phones free up physicians in terms of their spatial movements. Meanwhile, through temporal entrainment, it has a potential to disrupt physicians' temporal routine. Future research should examine such contradictory consequences on temporal dynamics of new information technology artifacts.

Temporal boundary object

The work practices of physicians and nurses provide the empirical evidence that a temporal boundary (Schriber and Gutek 1987) exists between inter-dependent work groups operating under different temporal arrangements. Such temporal boundary must be integrated by work groups at critical points in their interactions to accomplish cooperative work (Barley 1988). Our study highlights the potential of information technology in bridging the temporal boundary between different work groups. For example, the medical information system plays a significant role in mediating the interactions between physicians and nurses in the completion of test orders. The test order sheet generated by the medical information system provides a locus for communication and coordination between physicians and nurses. Past research focused on the role of boundary objects in translating different knowledge representations between work groups. Our study suggests that information technology can function as temporal boundary object (Yakura 2002). Future work can examine how different types of temporal boundary objects can deployed to translate differences in different dimensions of temporal structures of workgroups.

Conclusion

Contributions

Our study extends the current IS research into the relationship between information technology and temporal practices in workplace. The temporal effects of information technology can be examined in the two closely connected concepts of the temporal behavior of work and the temporal behavior of working (Lee and Sawyer 2002). The former refers to the temporal nature of tasks and events, and the latter relates to how workers organize their time to deal with tasks and events. While prior research has explored how information technology changes the temporal condition of work (i.e., the temporal behavior of work), our study taps into the temporal effects of information technology on temporal organizing (i.e., the temporal behavior of working). Therefore, our study enriches the understandings of temporal effects of information technology in workplace.

As insights derived from an in-depth case study help draw specific implications (Walsham 1995), our understandings of the impact of information technology on temporality in work practices obtained from our specific context will be valuable in the future in other contexts. Thus, our study contributes to the systematic understanding of the relationship between the use of information technology and temporal organizing in workplace.

Limitations

Our study is not without limitations. Temporality in work practices is complex, and the temporal effects of information technology on temporal organizing may be complicated. In this study, we examined four temporal attributes (i.e., linearity, entrainment, regionalization, and autonomy). The temporal impacts of information technology may be manifested in other temporal attribute, as well. For example, the use mobile phones may spread the sense of temporal urgency among physicians, as physicians are set in a position not to miss anything, ready to switch immediately to what seems more important or more pressing. But our observations did not allow us to study the temporal attribute of temporal urgency. We will be able to offer a more comprehensive picture of the relationship between the use of information technology and temporal practices if more in-depth formal interview data are collected.

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