Temporal effects of information systems on business processes: focusing on the dimensions of temporality

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Abstract

This study investigates how information systems affect the temporality of business processes in organizations. It is first described how the dimensions of temporality were developed. Among the many dimensions based on other studies, eleven dimensions were selected for our purposes in investigating the external temporality in the first instance and tracing changes in temporality. We then identified six dimensions (duration, sequence, temporal location, deadline, cycle and rhythm) which could effectively assess the temporal effects of information systems. We used them to describe and analyse temporal changes which resulted from the implementation of Korea Trade Network in two case companies. Through the case study, this paper aims to provide a deeper understanding of information systems and temporality in organizational contexts. Differential cycles, polychronicity and changes in inter-personal or inter-departmental relations mediated by temporal shifts are presented for their implications on time, work and information systems. © 2000 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Information technology speeds up business processes and can save a lot of time in organizations. However, little other than speeding-up and time-saving is known

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about what is taking place between2–11 information technology and the temporal performance. The current understanding of the relationship looks mundane. This paper attempts to investigate temporal changes in business processes that are caused by information systems. We understand that speeding-up and time-saving are essential in analysing the temporal changes. However, we suppose that there are other aspects that are also important in describing temporal profiles of business processes, particularly in understanding temporal transformations by information systems. We also expect that knowledge of these aspects will help understand the very mechanism through which information technology increases the speed of business processes and reduces the time required to complete them.

While there is some research about time in organizations (Bluedorn & Denhardt, 1988; Clark, 1985; Das, 1990; Hassard 1989, 1996; Kavanagh & Araujo, 1995; McGrath & Rotchford, 1983), studies focusing on the relationship between time and information technology are few in either information systems research or in organization theory. Barley (1988) investigated the impacts of computer-based radiology equipment on temporality and social relations in hospital radiology departments. Influenced by Hall (1959, 1966, 1983), he employed a dichotomy of ways of organizing time: monochronic and polychronic ways. In the former, people do one thing at a time while in the latter several things are done at once. Barley found that the new computer-based equipment increased the monochronicity of radiologists' work by restructuring the duration, sequence, temporal location and rate of recurrence of events (these temporal dimensions will be explained later). It also led to the symmetry of temporal organization between radiologists' and technicians' work. Furthermore, the increased symmetry contributed to a decreased conflict between radiologists and technicians.

According to the imaginative analysis of Failla and Bagnara (1992), information technology causes profound changes in the time-frame patterns of the decision-making process. It also eliminates rigidity in work rhythms, giving flexibility. The organization of work is increasingly becoming less rigid in terms of time-patterns. This is especially true of professional work performed in offices with information technology supports. They "help to eliminate or diminish the importance of time-frames generally accepted as appropriate for performing a given activity" (p. 678). Furthermore, they distinguish different types of information technology by the stage of its development and differentiate its impacts on temporality; the impacts of information technology on time assume different patterns depending on the stages in the development of information technology. Three main stages of information technology, that is, the automation of routine activities by mainframe computers, decision support technologies by personal computers and the recent development of virtual reality technologies, have different meanings in terms of time. Other studies (Sahay 1997, 1998) also deal with time and space, but they do not view time as changeable (Lee & Liebenau, 1999) and do not seem to ask how information technology affects time.

This paper begins by introducing the temporal dimensions that we developed to describe and analyse temporal changes at work. Then it examines how an information system affects temporal aspects of business processes in a particular case. Through the case study we aim to provide a deeper understanding of the issue in organizational

contexts. Thereby, we try to explore implications of the temporal changes by information systems for work, systems developement and social relations among workers and work groups.

2. Temporal dimensions of business processes

To investigate how information technology affects temporality in organizational work, we first need to know what constitutes temporality. In other words, for analytical purposes, it is necessary to devise a set of variables which help to understand various aspects of temporality. We call these "the dimensions of temporality". Schriber (1986, 1987 with Gutek) and Zerubavel (1981), Schriber & Gutek (1987) and Zerubavel (1981) examined temporal aspects of social organization in the work place and, for that purpose, devised a set of useful notions.

2.1. Zerubavel's dimensions

Zerubavel delineated four major dimensions of the temporal profile of any situation or event: sequential structure, duration, temporal location and rate of recurrence (1981, pp. 1–9).

The *sequential structure* refers to in what order situations and events take place. It is in the nature of many events, activities and situations that they cannot all take place simultaneously and must, therefore, be temporally segregated from one another in terms of 'before' and 'after'. The sequential order in which events are arranged may sometimes be purely random. However, it is very often the case that it is rigid in the sense that events are not reversible. The *duration* concerns how long situations and events last. Numerous events in social life have relatively fixed duration on a regular basis. Most of the timetables and schedules we use would not be possible without the relatively rigid duration of events and activities in our daily life.

The *temporal location* is concerned with when situations and events take place. Locating an event at a particular point over the continuum of time is the basis of scheduling, by which we routinely fix events and activities at particular prearranged points in time — at particular hours, on particular days of the week and in particular months of the year. In general, most routine daily activities are scheduled in a fairly rigid manner for particular times of the day and for particular days of the week. Fixing the temporal location of events entails the norm of 'punctuality', which assigns a normative character to the acts of being 'early' or 'late'. The *rate of recurrence* is concerned with how often situations and events take place. When they occur repeatedly and regularly, they entail rhythms or cycles. For example, that a particular meeting is held every Friday implies that it has a weekly cycle.

The four dimensions above are separated for analytical purposes. In reality, they are closely connected to each other. For example, we cannot decide the temporal locations of a series of events, that is, we cannot make a schedule for them, if we don't know their durations, sequences and patterns of recurrence.

Zerubavel also emphasized the conventionality of the four dimensions (1981, pp.

2–11). As for the sequential structure, some irreversibilities are determined by nature or are inevitable from a logical or technical standpoint. In a research process, for example, data collection precedes data analysis which is followed by writing a report. However, it is merely artificial convention that underlies most of our social customs such as serving soup before, rather than after, serving meat. Similarly the sequences of many bureaucratic procedures are by no means natural and inevitable, although they may have good organizational rationales. Under various circumstances, for example, office automation, the sequential structure of these procedures may be altered. In general, many socially based irreversibilities are conventional and symbolic in nature. This is also true of duration. The durational rigidity is often technologically or biologically determined. However, it is also conventional as seen in, for example, working hours (8 hours), tea time (about 20 minutes), classes at school (50 minutes) and so on. Although some may insist that the 8-hour working day meets with our biological requirements or is within our psychological limitations of concentration, it is evident from history that it is the social and historical product of a continuing struggle between labour and management.

2.2. Schriber's dimensions

Schriber (1986) and Schriber & Gutek (1987) examined the existence of norms about time in organizations and tested for differences in temporal norms among organizations, work group types and occupations. Results showed, for example, that work group types differed in their perceptions of the length of work cycles and work rhythm patterns. Organization types differed in the importance of schedules and deadlines and the efficient use of time. Schriber and Gutek reached a conclusion that time (or, more precisely, norms about time) is an underlying aspect of organization culture which "can be thought of as a shared set of assumptions, beliefs, and values" (Schriber, 1986, p. 52).

They developed an instrument to measure temporal norms. It consists of the following dimensions. *Allocation* is the amount of time, whether planned or expended, devoted to a task or activity, regardless of when the amount occurs. This is primarily concerned with size or amount and is based on a conventional standard of measurement (e.g., hours or minutes). *Scheduling* concerns the location of activities and tasks in the temporal realm (e.g., a meeting at 10 a.m.). The temporal boundaries provided by scheduling can be further defined in terms of sequence, deadlines, punctuality, pace and buffers.

Sequencing is at the heart of the concept of scheduling. It refers to "actions follow-[ing] one another in a prescribed order" (Moore, 1963, p. 8). *Deadline* is also implicit in the concept of scheduling. Deadlines are temporal start and stop points, and can be external or internal to the task, or both.

Punctuality is the degree of rigidity to which deadlines are adhered. Some deadlines require tasks to be completed on a certain day, others require completion by a certain hour of a specified day, and still others require completion by an identified minute of a particular hour. *Pace* is the rate at which activities can be accomplished.

It is a measure of the speed of activity or the number of activities that can be done within a given interval of time. Allocation, scheduling and deadlines depend on pace.

Temporal buffers are unspecified amounts of time that are built into schedules to allow for the uncertainty in the estimated duration to accomplish a task. The necessity of buffers is evident in lags and delays, and they provide organizations with temporal elasticity. *Autonomy* is the amount of freedom the job holder has in setting schedules for the completion of his or her tasks over time. It measures the degree to which respondents perceive autonomy over the use of their time.

There are two types of temporal boundaries which are relevant to work and organization culture. *Intraorganizational time boundaries* separate work groups from one another. The uses and meanings of time create group boundaries that indicate membership values and expected behaviour patterns (Zerubavel, 1981, pp. 64–69). For example, workers in one department may habitually work under tight schedules and experience pressure to be punctual, whereas another department may have a more temporally relaxed atmosphere. *Time boundaries between work and nonwork* measures the amount of intrusion of job responsibilities into worker's personal time. For some workers, these boundaries may be more permeable than they are for other workers. For instance, some workers usually take work home with them; others do not.

The concepts of synchronization and co-ordination help frame the temporal concerns around the performance of multiple tasks or activities by individuals or groups. *Synchronization* is managing the performance of more than one task simultaneously. Think, for example, of three people trying to free a car that is stuck in the snow. If each pushes on the car individually or in sequence there is little hope of moving the car. However, if they synchronize their activity, there is a better chance that they will successfully free the car. *Co-ordination* refers to managing the performance of more than one task in sequence. Thus, the car must be put in the proper gear before three helpful individuals begin to push.

Routinization implies repetition at appropriate times — it has cyclical characteristics both in the content of the activity and its placement in a schedule. The expectation is for smoother and more accurate performance of the behaviour with each repetition, and perhaps for the eventual shortening of its duration or for an increase in pace. In addition, as dimensions of temporal norms which are important to understand organization culture, Schriber suggested awareness of time use as a resource, future orientation and the norms regarding trade-offs between the quality of work and the speed of work over time (quality vs speed).

2.3. The comparison between Zerubavel's and Schriber's dimensions

The two sets of dimensions of time are contrasted with each other, although Zerubavel's sequential structure, duration, temporal location and rate of recurrence respectively correspond approximately with sequencing, allocation, scheduling and pace in Schriber's (Table 1). In order to compare Schriber's and Zerubavel's dimensions, we introduce Barley's distinction between structural and interpretative aspects of a temporal order. Whereas structural attributes refer to the external contours of a

Table 1
Zerubavel's and Schriber's dimensions

Zerubavel	Schriber
Sequential structure	Sequencing
Duration	Allocation
Temporal location	Scheduling
Rate recurrence	Pace
	Deadlines
	Punctuality
	Temporal buffers
	Autonomy
	Time boundaries (interorganizational and between work and nonwork)
	Synchronization and co-ordination
	Routinization
	Awareness of time use as a resource
	Future orientation
	Quality of work vs the speed of work

temporal system, interpretative aspects are concerned with what people perceive and interpret from the structural aspects (Barley, 1988, p. 128). For structural attributes he adopts Zerubavel's four dimensions, and then explains the relationship between structural and interpretive aspects as follows:

> People employ these structural parameters of temporal order to make sense of events that occur in the course of their work. Interpretations so cast compose the internal parameters of a temporal world, parameters that are not as immediately obvious to a casual observer. By evaluating events against a shared scheme of expected sequences, durations, temporal locations, and rates of recurrence, people judge whether they are bored, whether something is wrong, whether they have done a good job, or whether others have acted responsibly. Such interpretations not only enable us to lend meaning to events in our work worlds; they lead us to form opinions and make pronouncements about the behaviour of persons operating in alternate temporal systems (1988, p. 129).

In Barley's account, Zerubavel deals with "structural aspects of a temporal system" which can be described reliably by an independent observer, whereas Schriber is concerned with "interpretive aspects" which cannot be described easily by an observer. Schriber investigates "the perceptions of temporal rules and customs governing behaviour in work organization" (Schriber & Gutek, 1987, p. 644). She asks "what people in your organization think about time in the workplace" (1986, p. 274), and "what most people you work with expect" (p. 277). Whereas Zerubavel is interested in the amount of time actually spent to complete a task when he mentions duration, Schriber asks respondents to evaluate sentences about (the adequacy of) the allocation of time for tasks. The sentences are, for example, "We never seem to

have enough time to get everything done" and "People expect to finish their work by the end of each day".

2.4. The development of temporal dimensions

To develop the temporal dimensions for this study from the two sets above, we took two stages of selection: the first based on the characteristics of the research, and the second based on exploratory empirical work.

2.4.1. The first selection

The first stage of selection was done based on both the characteristics of this research and the differences between the two sets. First of all, this research is more interested in structural or external aspects of temporal order than interpretative ones. In this sense, it is closer to Zerubavel's work. This does not mean that we ignore the importance of interpretative aspects. As Barley (1988) insists, structural aspects are necessary but insufficient conditions for facilitating social changes. Hence interpretative aspects should also be considered when we investigate, for instance, the effects of information technologies on temporality in organizations, and further-more on social relations. However, we believe that priority should be given to external aspects over interpretative ones. In general, interpretations follow, rather than precede, external changes. In order to know the interpretative aspects of any change, we should investigate external aspects first. Whereas Schriber is only concerned with attitudes, ideas or perceptions of (norms of) time, the present research pursues external aspects of temporal order first, then pays attention to the perceptions of temporal norms. Normative aspects of temporality should be preceded by the study of the external aspects.

Secondly, this research is dynamic, whereas Schriber's is static. This research intends to trace changes in temporality caused by a new information system. Comparisons between before and after its introduction are made across temporal dimensions. It considers temporal order to be changeable (Lee & Liebenau, 1999). In contrast, Schriber tries to find the existing temporal norms which dominate a specific organization, and to compare them among organizations and work groups.

The two characteristics above functioned as the criteria by which some are selected and others are abandoned from Schriber's dimensions. Future orientation, awareness of time use, and quality vs speed are disregarded because they are concerned purely with perceptions of values or norms, with no reference in external reality. Routiniz-ation is also abandoned because it has more to do with the deskilling issue in labour process theory (Braverman, 1974) rather than the temporal one. Instead cycles and rhythms (Schriber, 1986) are selected and modified. Time boundaries between work and nonwork are deleted because nonwork time is out of the scope of this research, which is only concerned with time at work. Autonomy is excluded because it is not an external aspect of temporality. It is rather what can be derived from the changes in external temporality, and what can be understood from the interpretation of social relations which have temporal implications. Others are accepted because they seem to be able to adapt themselves to trace external aspects of temporal order. This led to 11 dimensions as presented in Table 2.

Table 2
Eleven dimensions at the first stage

Dimensions	Descriptions
Allocation	the amount of time devoted to a task or activity: it is compared before and after the use of information technology.
Scheduling	the location of activities and tasks at particular points over the continuum of time: when does an activity take place?
Sequencing	the order in which activities and tasks take place: the importance of a specific order and the possibility of changing the order are examined.
Deadline	the temporal start and stop points: its existence and the importance of meeting deadlines are examined.
Punctuality	the degree of rigidity to which deadlines are adhered: the importance of 'being punctual' and the unit of measuring punctuality are investigated.
Pace	the rate at which activities can be accomplished: it concerns the speed of work and the people's expectation to work fast.
Temporal buffers	unspecified amounts of time built into schedules to allow for the uncertainty
Synchronization and co-ordination	synchronization is managing the performance of more than one task simultaneously; co-ordination refers to managing the performance of more than one task in sequence.
Cycle	the regular recurrence of events and processes: it attempts to profile the cycles in work processes experienced over time.
Rhythm	the alternation in the intensity of being busy: the degree of being busy varies throughout a working day, and the intensity of work load increases and decreases alternately.
Time boundaries within the organization	group boundaries created by the differences in the uses and meanings of time: any differences in the dimensions described above among job groups or departments are sought after.

2.4.2. Selection by pilot study

To test the relevance of the 11 dimensions derived from Zerubavel (1981), Schriber (1986) and Schriber & Gutek (1987), we conducted a pilot study. We hoped to ensure that they met the research purpose to describe the changes caused by information technology in the external aspects of temporality of business processes. During the pilot study, interviewees raised questions about the relevance of some dimensions. They stated that some dimensions overlapped so that they found it difficult to distinguish them from each other both conceptually and empirically. Definitions of some dimensions were confusing at the conceptual level, and they could not find something external that corresponded to those concepts. This discovery led us to focus on six dimensions. This reduction is justified by the need for flexible data collection in an exploratory case study (Eisenhardt, 1989, p. 539). The reasons for the changes are as follows.

'Allocation' is replaced by 'duration' as used by Zerubavel. The term 'allocation' is discarded because it implies that something is decided beforehand by schedules or by persons who make schedules. 'Duration' is concerned with the amount of time

spent to complete a task or activity and answers the question of how long it actually lasts in practice.

'Scheduling' is replaced by 'temporal location'. The former is not a particular aspect, but the combination of a variety of temporal aspects in that schedules and timetables are based on duration, deadlines and so on. To designate the location of activities and tasks at particular points over the continuum of time, 'temporal location' is employed instead. It concerns when activities take place.

'Sequencing' undergoes a minor change into 'sequence'. 'Sequencing' implies that the order of activities is planned by actors. It is an aspect of what sequence addresses. 'Sequence' refers to the order in which activities and tasks take place. 'Deadline' remains with some change of its definition. It refers to the fixed time by when work is to be done. 'Punctuality' is excluded because it does not have an external representation to be traced. 'Punctuality' is a norm. In addition, people in the pilot study did not think that the importance of punctuality could change by the new system. The notion of punctuality is not considered relevant for the research which investigates the external dimensions of temporal order. It can be addressed when deadline is examined.

'Pace' is the rate of occurrence which is concerned with how often situations and events take place within a given interval of time. It is a measure of the speed of activity. According to Zerubavel, when events occur repeatedly and regularly, they entail cycles. In this research, therefore, pace is not dealt with separately but included in the dimension of 'cycle'. 'Temporal buffers' are discarded. Interviewees in the pilot failed to be aware of temporal buffers. They were confused and asked for further explanation. Such things as temporal buffers were not found.

'Synchronization' and 'co-ordination' are excluded. The tasks under study are relatively simple, and they do not require the synchronized performance of multiple tasks by multiple persons. They often require the involvement of several persons working in a co-ordinated sequence for their completion. Because the co-ordinated sequence is in a simple form, however, it is covered in the sequence above. In summary, synchronization and co-ordination could not be traced in the fieldwork site.

'Cycle' remains as the periodic regularity in which work is completed repeatedly. 'Rhythm' also remains, referring to the alteration in the intensity of being busy. 'Time boundaries within organizations' are excluded because it is found out that contrary to our expectations, they do not have externalities and are closer to interpretive aspects.

In summary, the original 11 dimensions were reduced to six (Table 3). Given the six dimensions, the basic procedure of the fieldwork was first to investigate external changes in the six dimensions after the introduction of a new system, and then we attempted to find their significance for temporality and work in organizations.

3. Case study

3.1. The cases studied

Case studies were conducted in two Korean trading companies which participated in the trade automation project KTNET (Korea Trade Network), an EDI application.

Table 3
Six dimensions of temporality

Original 11 dimensions	Modified 6 dimensions	Definition
Allocation	Duration	the amount of time spent to complete a task or activity
Scheduling	Temporal location	the location of activities and tasks at particular points over the continuum of time
Sequencing	Sequence	the order in which activities and tasks take place
Deadline	Deadline	the fixed time by when work is to be done
Punctuality	Excluded	
Pace	Excluded	
Temporal buffers	Excluded	
Synchronization & co-ordination	Excluded	
Cycle	Cycle	the periodic regularity in which work is completed repeatedly
Rhythm	Rhythm	the alternation in the intensity of being busy
Time boundaries	Excluded	

KTNET was chosen because we expected that we could easily trace and contrast old and new ways of work; it had substantially changed trading procedures in the companies just before the fieldwork started. The field sites were the departments which used KTNET at hand to do export business. Of the export work, four domains to which KTNET had been applied were chosen: export letters of credit advice, export licenses, local letters of credit and negotiations. Each domain consists of procedures. They represent the steps to be followed to complete the work required in the domain. Each domain or part of it is a task to be conducted from the viewpoint of a worker in charge. In the same way, each procedure is a unit task for the worker. A unit task is the smallest element of each task in a conceptual sense, not in a physical sense. We do not go so far as to divide each unit task into even smaller elements physically as the advocates of time and motion study of work do. For us, the smallest unit is that which the key informants and the workers involved perceive and describe their work.

3.2. Data collection

Three different types of data were collected during the fieldwork:

1. working procedures before and after KTNET in each domain,
2. changes in the six dimensions of external temporality, and
3. organizational implications of those temporal changes.

For the first type of data, the main sources were interviews with the key informants in each company. They explained the working procedures before and after KTNET

in each domain in detail. They were asked to produce diagrams describing the procedures. They also provided internal documents which confirmed or supplemented the diagrams they produced. Then the workers interviewed were shown the diagram of the domain under their charge and asked whether it was correct. They reconfirmed most of the diagrams and disagreed with part of some. When differences were found, the key informants were contacted again and asked to correct them, if necessary. The products of this process are shown in Figs. 1–4.

For the changes in the temporal dimensions, the two diagrams of the working procedures pre- and post-KTNET in each domain were used as a starting point. Showing the interviewees the two diagrams, questions on the six dimensions were asked in turn. For the organizational implications, we examined some issues raised by previous studies. They became the basis of the discussion in Section 5.

3.3. The export process and the changes since KTNET

Before we examine temporal changes caused by KTNET, we will present the whole process of export documentation work briefly. The work that this paper deals with begins with the completion of an export contract. Once an order is placed, a worker in a business department, whose job is to assist, enters the order into the internal information system which gives a file identification number to each order. Then another worker in the same department, whose job is business-oriented, calculates the cost which will occur in following-up the order. Sometime later the master letter of credit (L/C) for the order arrives in the bank headquarters concerned. The bank delivers the master L/C either to the company electronically, or to the appropriate branch through the internal mail. In the latter, the branch informs the company of its arrival, and the company sends its worker to fetch it. The L/Cs are distributed to the appropriate business departments. Workers in business departments match the master L/C delivered with an appropriate order in the internal information systems.

Next, the business department needs an export license (E/L) from a transactional bank. The assistant worker (often female) prepares a series of documents to apply for it. When they are ready, she delivers them to the department responsible for the application or transmits them directly to the appropriate bank via EDI. Meanwhile, the main worker decides from which manufacturer he will order the goods to be exported. Once the deal is done, the assistant prepares for the application of a local L/C, arranging a set of documents. Then she makes a request for opening the local L/C to the foreign exchange department, which in turn checks it to make sure that all the necessary documents are in order, and takes them in person to banks or transmits application messages via EDI.

Once the shipping request is completed and the invoice prepared, a request for export clearance is made. Then, the export permit is issued from the Customs Office, and a bill of lading arrives from shipping companies. Now the main worker calculates all the costs incurred so far. Then the assistant prepares the file for negotiation to be delivered to the foreign exchange department. When it is ready, she makes a request for negotiation to the department, which in turn negotiates with banks. When

negotiations are completed, bills are transferred to the accounting division, where at last the process finishes.

Among the four main steps (export L/C advice, E/Ls, local L/Cs and negotiations) to which KTNET was applied during the fieldwork period, this paper presents domains of local L/C and negotiation in detail to show how the investigation was conducted.

3.3.1. Local L/Cs

An L/C is the most common way to assure payment in international trade. The basic of L/C is a bank-issued instrument which promises to pay a seller when the buyer satisfies certain stipulated conditions. When those conditions are fulfilled, the bank is obligated to pay the seller. A local L/C is a domestic version of a (master) L/C. Its principle and function are the same except that the parties concerned (exporters, manufacturers which supply the goods to be exported, and banks) are all located within the same national territory. It is issued by a bank at the exporter's request using the master L/C as collateral. Manufacturers or suppliers of the export goods get paid regardless of the terms in the master L/C once they deliver the goods within the promised date and hand documents over to the bank as specified in the terms of the credit.

Two different kinds of teams within the companies are involved in local L/C: business departments and assisting teams. While business departments deal with main export businesses of their specialized items, assisting teams support administrative activities of business departments. Each assisting team supports several business departments.

3.3.1.1. Procedures before KTNET
The procedures before KTNET are described in Fig. 1. After business teams received offer sheets and specifications of the export goods from manufacturers or suppliers, they began to prepare for local L/C applications. Assistant workers in business departments made photocopies of the documents, got them inspected, and took them to the assisting team by 11 a.m. The documents had to arrive by then to be processed properly during the working day.

The workers in charge in the assisting team listed the day's local L/C applications, breaking them down by bank and currency. They faxed the list to the appropriate banks between noon and 13:00 h. The banks briefly notified registration numbers by telephone. Then they filled in the application forms and arranged necessary documents for submission. After the supervisor signed the forms, they went to the appropriate banks, usually at 16:00 h. In this visit, they not only submitted the day's applications but also collected the local L/Cs applied during the previous day. Returning to the office, they made data entries into their management information system and then classified local L/Cs by business department and distributed them. When they were busy, the data entry was often postponed. It could be done by batch later.

3.3.1.2. Procedures after KTNET
The procedures implemented after KTNET are shown in Fig. 2. Under the EDI system, workers in charge of local L/C in business

Business department	Assisting team	Bank
to receive an offer sheet and a specification of items from manufacturers 1> to make photocopies of the offer sheet and specification 2> to get them inspected by supervisors		

hand carry

3> to make a list of received applications
4> to send the list by fax to the appropriate bank

5> to receive local L/C registration numbers by phone from the bank
6> to draw up application forms

7> to arrange documents (two copies per application) for submitting

8> to get signed by supervisors

approved

9> to visit the bank to submit and collect the local L/Cs submitted on the previous day

10> to enter data into MIS

11> to distribute local L/Cs to the appropriate departments
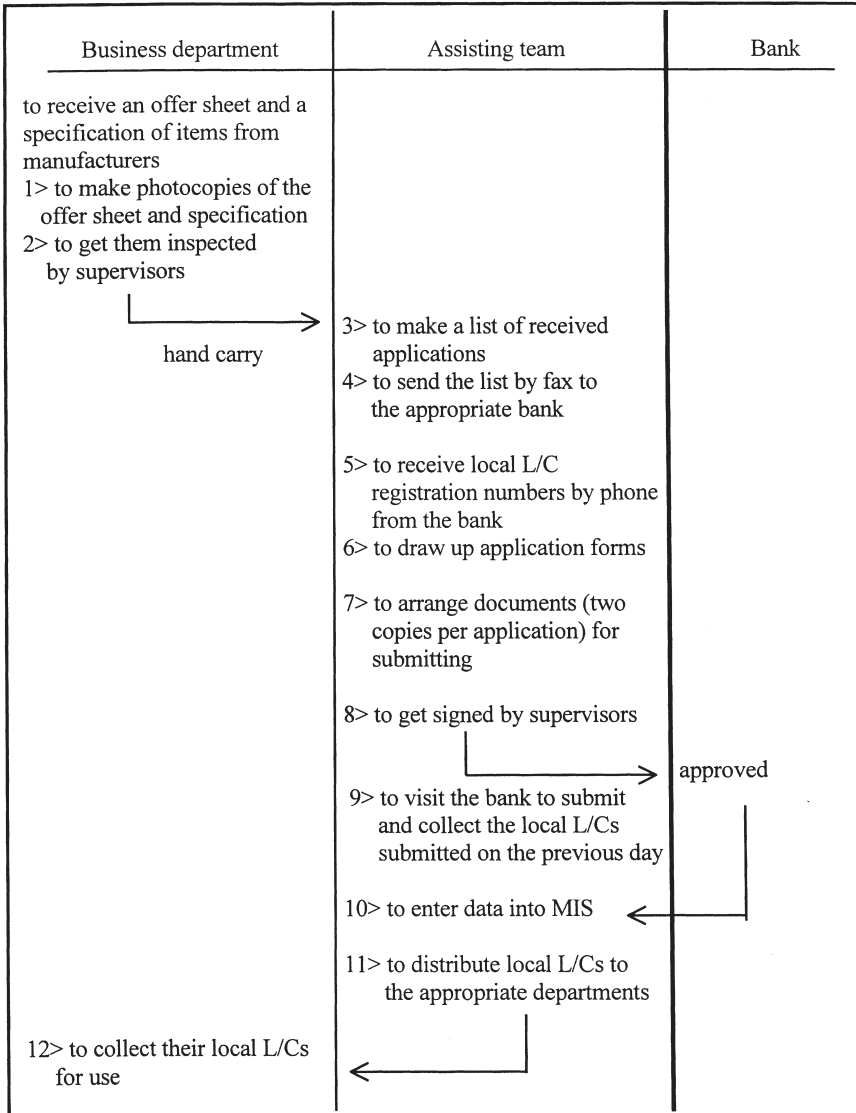
12> to collect their local L/Cs for use

Fig. 1.   Procedures for local L/C before KTNET.

departments enter data into the system, instead of making photocopies of documents. Data entry consists of two parts; one is for the internal MIS, the other for the EDI process. Then applications in electronic form are transmitted to the assisting team with the relevant documents being sent at the same time. In the assisting team, the documents on paper and the contents in electronic applications are compared. If no error is found, or after any correction, the applications are transmitted via KTNET

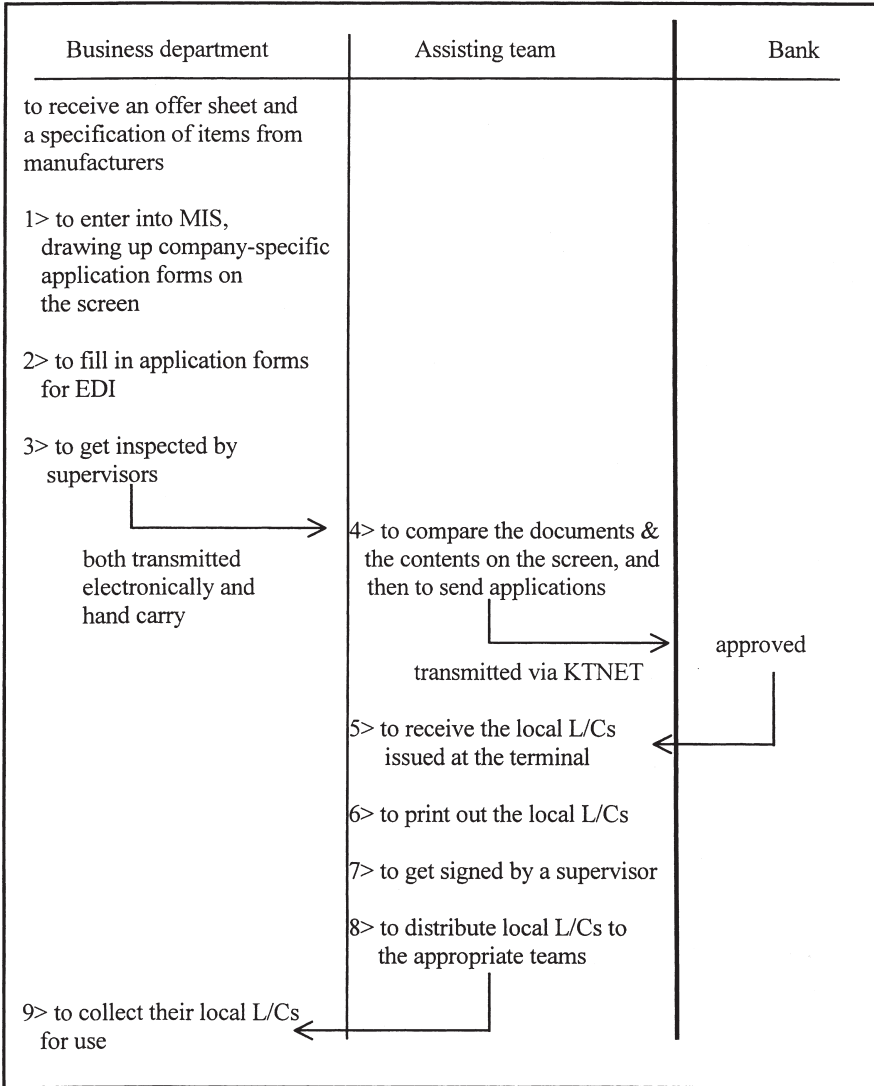| Business department	Assisting team	Bank
to receive an offer sheet and a specification of items from manufacturers		
1> to enter into MIS, drawing up company-specific application forms on the screen		
2> to fill in application forms for EDI		
3> to get inspected by supervisors	4> to compare the documents & the contents on the screen, and then to send applications	
both transmitted electronically and hand carry	transmitted via KTNET	approved
	5> to receive the local L/Cs issued at the terminal	
	6> to print out the local L/Cs	
	7> to get signed by a supervisor	
	8> to distribute local L/Cs to the appropriate teams	
9> to collect their local L/Cs for use		

Fig. 2.   Procedures for local L/C after KTNET.

to the banks. It takes just 10 minutes to compare and transmit. The transmission takes place between 11:00 h and 13:00 h in one company (A) and between 13:00 h and 14:00 h in the other company (B) as agreed with the banks concerned. The local L/Cs issued return to the company around at 17:00 h in company A and at 15:00 h in company B. It takes about 30 minutes to print out them. Business teams usually collect their local L/Cs the next morning.

As they did under the manual system, the workers in business teams have to

complete the entry before 11:00 h. It is a deadline, but now it is less rigid than before KTNET. Previously, there was much work for the assisting team to do before submitting local L/C applications to the banks, which used to take 3–4 hours. In order to be able to submit on the same working day, the 11:00 h deadline was very important, but now under the new system it is not. A clerk in charge of local L/C in the assisting team in company A commented:

> The treatment of local L/C is a small part of the whole work for the workers in business departments. However, this is my major duty. The business teams quite often missed the 11 o'clock deadline when they were busy. Therefore I always used to urge and press them repeatedly to meet the deadline, which meant lots of uneasiness between us and the workers in business departments. Now this kind of trouble has almost disappeared because we are not tied up with the deadline that firmly. Though we still have to transmit the applications to the banks between 11:00–13:00 h, there is not much work to do before the transmission. It is not as urgent as it was. My position with regard to business departments has changed from urging to helping.

Now, after applications for local L/C arrive via MIS and by hand delivery, there is less work for the assisting team to do than before. Therefore the pressure to be punctual has decreased, and the assisting team does not urge business departments to be punctual. Even when business departments do not turn them in on time, it is not pressing for the assisting team. For workers in business departments, however, it has made little difference; the workload has increased mainly because the data entry is allocated to them. It has to be done by noon at the latest. For them the deadline still has to be met although it is said to be less rigid.

3.3.2. Negotiation

Negotiation is the final stage of an export order. Business departments prepare a set of documents and hand them over to the foreign exchange department. Negotiation is mainly conducted by this department which has frequent transactions with banks. By delivering a set of documents required by the terms on the L/C to the bank, the trading company is entitled to get paid for the export order for which the company has completed the requirements stipulated on the contract.

Descriptions of negotiation here are based on the fieldwork in one company (B). The EDI system for negotiation was implemented by the company during the fieldwork period. This gave us a good opportunity to observe and describe in detail changes in negotiation procedures comparing those before and after KTNET. As will be described later, some documents for negotiation have to be submitted in person to banks even under the new systems. This seems unavoidable under current legal and technical conditions (as of 1996). While there has been much change in procedures within the company, there is little when it comes to its transactions with banks.

3.3.2.1. Procedures before KTNET   Fig. 3 describes negotiation procedures before KTNET. In the foreign exchange department, there are two different groups of workers responsible for negotiation. One group, called 'checkers', examined the accuracy and consistency of data on various documents related to a single order. The other

Recipient & Supervisor	Checkers	Bill workers	Bank
1> to receive documents for negotiation from business departments - to enter the date into MIS			
2> to classify negotiation documents by bank - to decide the day's amount of negotiation for each bank			
	3> to check the correctness of documents	4> to collect documents for the day's negotiation (by checkers)	5> to apply for negotiation
		6> to enter data of negotiation in detail	7> to collect the bills
		8> to enter the bills into the MIS	
		9> to print the bills	
	10> to receive the bills		
11> to sign			

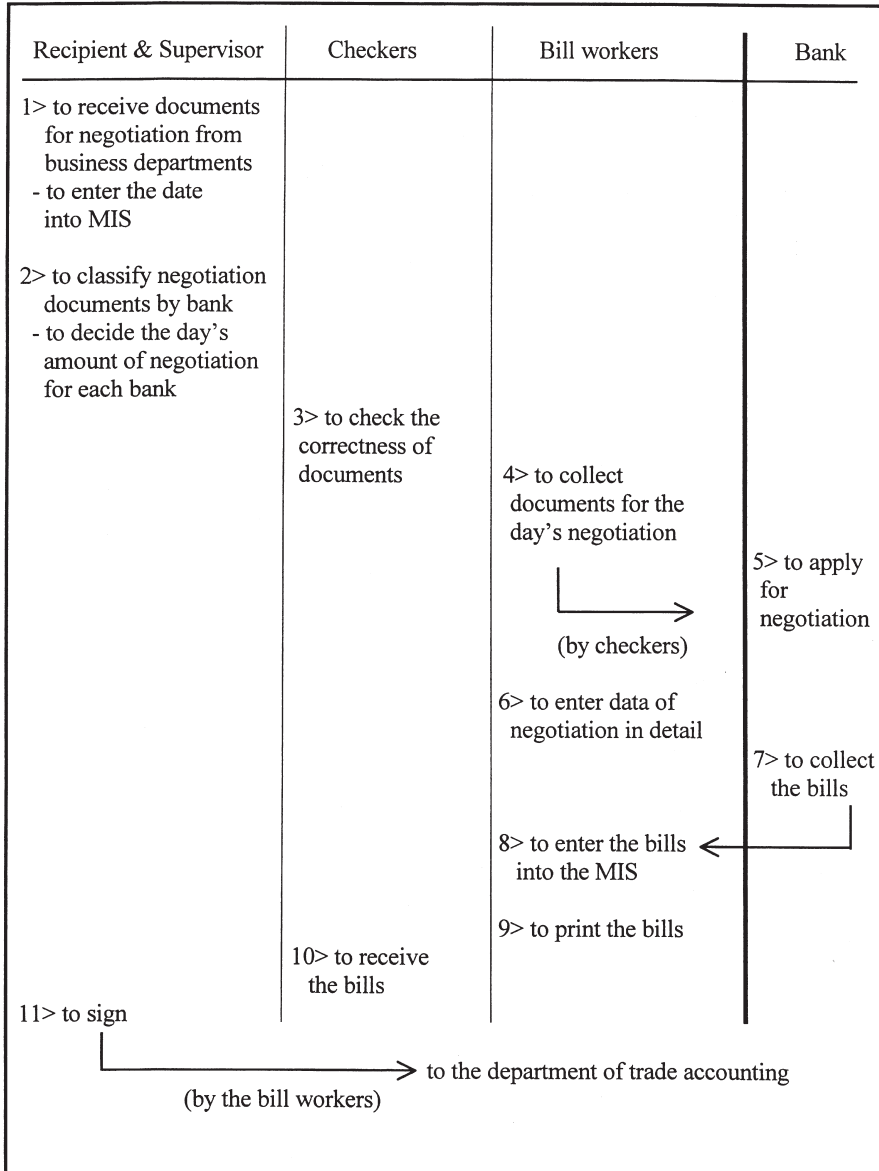to the department of trade accounting
(by the bill workers)

Fig. 3. Procedures for negotiation before KTNET.

group conducted most of the tasks involved in negotiation such as data entry and other trivial jobs. They were called 'bill workers'.

Documents for negotiation arrived in the department from business departments. Various documents were required for each negotiation, such as a summary cover, bill of lading, commercial invoice, insurance documents, packing list, country of origin certificate, a photocopy of the L/C, bill of exchange, export permit, shipping advice and so on. The worker in charge of receiving them entered into the system the order number and the date. The supervisor of the department distributed negotiation orders received on the day to each bank. In so doing, he decided on the amount of money to be negotiated on the day for each bank. He had to finish the task by 10:00–11:00 h so that that the finance department was able to know the amount of money (foreign currency) available for the day and to make the day's plan for managing cash flow. Then the documents were distributed to checkers who took charge of specific banks. They began to check documents. They examined, for example, whether the L/C numbers were copied exactly on all the documents and whether all the documents required in the L/C were prepared. They checked from around 10:00–11:00 h when documents were allocated by the supervisor, to around 17:00 h by which time examination had to be completed and handed over to the bill workers. The latter time was an important deadline in the office.

The bill workers collected negotiation documents for the day. The amount of the day's negotiation for each bank was decided beforehand in the morning by the supervisor who considered the demands of the finance department. They then filled in an application form for the day's negotiation. They sent the form by fax to the bank concerned before they delivered related documents in person. This usually started at about 17:00 h and took 1.5–2 hours. Then at around 18:30–19:00 h the checkers with relevant documents visited the banks allocated to them and submitted the documents for negotiation.

The bill workers entered negotiation data on summary covers and photocopies of invoices into the internal system. In principle this data entry would take place the next morning, but in practice it may not have happened until 2 or 3 days later. In either case the data entry had to be finished by 10.00 so that the company could know the previous day's sales. The bill workers then collected negotiation bills from bank branches. The time for bill collection was not fixed. It was done when they visited the branches for other businesses. Normally there were occasions in which they needed to go to the branches. Having returned to the office, they entered data on the bills into the management information systems. Doing this entry, they compared the amounts (for example, of postage fee) on the bills issued by banks and the amounts which were calculated by the system and displayed on terminals. If differences were found, they corrected data on the internal system or made complaints towards the bank concerned. Then they entered the banking charge, delay charge and cable charge on the bills into the system. This entry happened at unspecified times of the day. They printed out the bills of their own and passed them to checkers, who got them signed by the supervisor. These two tasks also happened at unspecified times, i.e. when they were less busy.

After the bills were signed by the supervisor, checkers returned the bills to the

bill workers, who delivered them to the trade accounting department. In principle, the signed bills were to be delivered to the accounting department every day. In practice, however, the bill workers did not process them on a daily basis as ruled in the company's regulations. They kept bills accumulated for several days on their desks and passed them to the trade accounting department in bundles. First of all, they were so busy that they could not deal with them properly every day. The department normally dealt with 130 negotiations a day on average. On busy days, it can be more than 160–170 orders. In addition, the trade accounting department did not want to have them every day. The accounting department runs on a monthly basis, i.e. it closes the books at the end of every month to make a monthly report on final accounts. For this purpose, it sets deadlines by which other departments must submit their bills of transactions which have occurred for the month. For negotiation, the first deadline is usually on the 28th or 29th day of every month and the second one is on the 4th or 5th day of the next month.

The bill workers in the foreign exchange department passed the majority of the negotiation bills to checkers and the accounting department towards the end of every month although the bills became available evenly across the month. Therefore, as the deadline days approached, all the workers in the department became extremely busy. Work was not evenly distributed across the month, but concentrated on specific days of every month, usually on early days of, and towards the last day of, every month.

3.3.2.2. Procedures after KTNET   Fig. 4 describes procedures after KTNET. A significant change since the introduction of KTNET is that the job of entering data has transferred from entry workers to checkers. Now checkers examine documents for negotiation as they did before, and at the same time enter related data into the internal system. They complained that their new job of simultaneous examination and data entry was an excessive workload. Behind the overt complaint, there is another grumble, though unspoken, that they are relegated to the data entry job which had been considered non-knowledge work. However they accepted the direction which the department and the company chose for enhancing efficiency, and soon got accustomed to the new way of working.

Up to stage 5, working procedures are the same as before the introduction of KTNET. The new system has removed bill workers' visits to banks for bill collection. Now the bank branches transmit electronically the negotiation bills after proper administrative work. Because all the data are already entered first by checkers and then by tellers in banks, bill workers only check whether the bills have arrived and examine whether they are consistent with calculations by the company's system. If differences are found, they correct them or discuss them with the persons responsible in the bank. Then the bills are printed out and passed to checkers for signing by the supervisor. The bill workers transfer them to the trade accounting department. As the data entry is eliminated from the bill workers' work, i.e. as they are less busy, they can now deal with the delivery of the bills more frequently, which used to be done irregularly, that is, when they were relatively less busy. They now print out and pass to the accounting department fewer bills on a more frequent basis, which
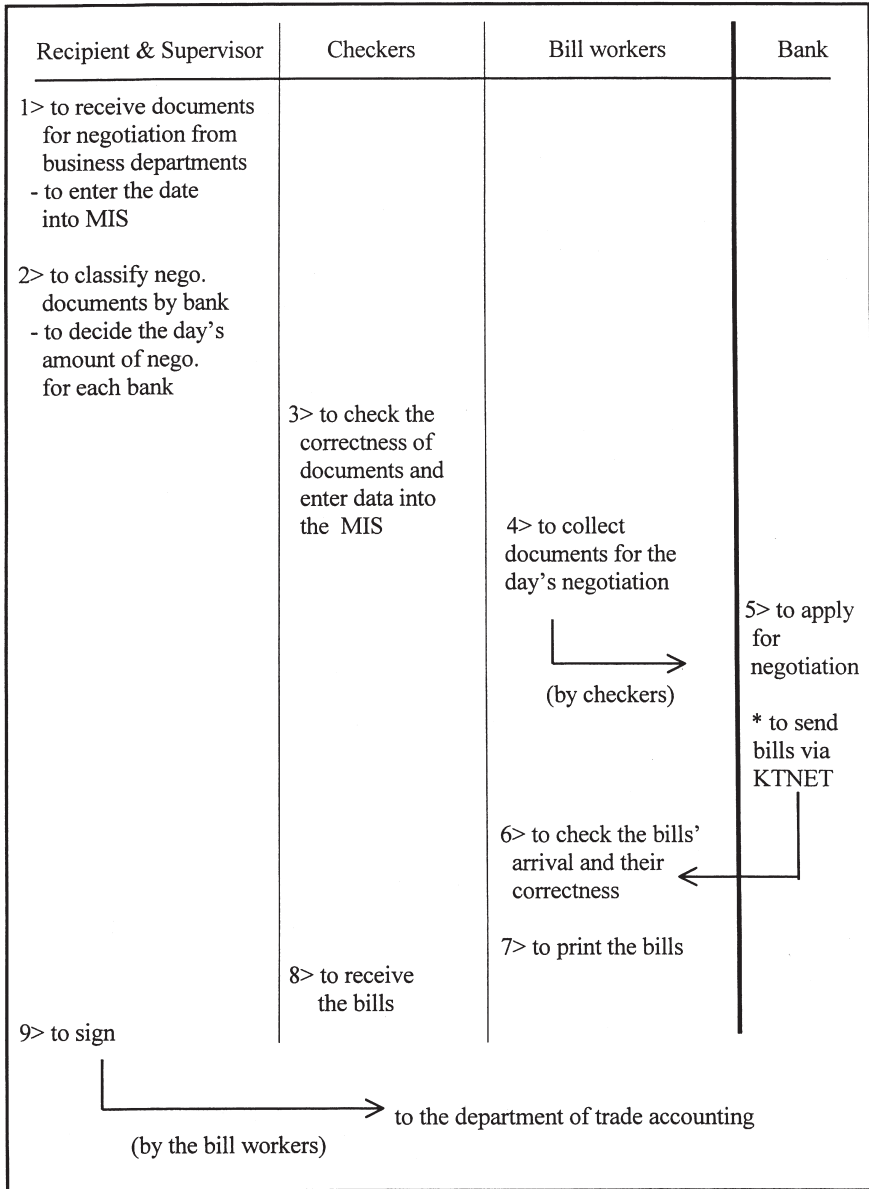
Recipient & Supervisor	Checkers	Bill workers	Bank
1> to receive documents for negotiation from business departments - to enter the date into MIS 2> to classify nego. documents by bank - to decide the day's amount of nego. for each bank	3> to check the correctness of documents and enter data into the MIS	4> to collect documents for the day's negotiation → (by checkers) 6> to check the bills' arrival and their correctness 7> to print the bills	5> to apply for negotiation * to send bills via KTNET
9> to sign → to the department of trade accounting (by the bill workers)	8> to receive the bills		

Fig. 4.   Procedures for negotiation after KTNET.

decreases the extent of work concentration around the early and last days of each month.

4. Changes in the temporal dimensions

In the last section, we have described how KTNET, an EDI application, changed procedures in two domains of export work. Now we will focus on the six temporal dimensions. Table 4 summarizes the changes in the dimensions across the four domains examined. In the table, (+) signifies a remarkable change and ( ) signifies no change. In describing the changes in each temporal dimension, we not only draw on local L/C and negotiation, but, when necessary, we also use the other two domains that are not covered in the discussion of the paper in order to show the whole profile of the change.

4.1. Duration

It is quite clear that information technology reduces the duration of tasks as its promise has always insisted. The reduced duration can be attributed to two sources: the replacement of physical delivery of documents with electronic transmission, and the reduction of time in conducting each unit task itself. Duration here refers to the latter. Time consumed for delivery may include 'waiting time' in which documents are waiting before they go through the next step. The reduction in delivery time is not included in the discussion of duration in this paper because it is self-evident and reflected in the changes of cycle, which is another dimension of temporality. For the reduced time for each unit task, the comparison between before and after KTNET is not simple. Once a new system is introduced, unit tasks themselves are subject to radical change. Therefore comparisons of duration of unit tasks are not always possible. As seen in Table 4, duration is affected in all the four procedures examined in the fieldwork. The reduction is mainly attributed to the elimination of repetitive data entries and the removal of some paper work.

4.2. Sequence

A new technology may cause changes in the order in which work is done. As in the duration, however, the comparison of sequences before and after a new technology is not easy because it may bring a radically new way of working in which old unit tasks disappear or at least it reduces the number of steps required to complete the whole job.

As Table 4 shows, sequence is affected in three domains: E/L, local L/C and negotiation. Before KTNET, data entry in E/L and local L/C could be performed at any point in the order in which work was done because the processing of an E/L and a local L/C was not incorporated into the internal information system. After the processing was completed, data produced in the work processes were put into the system. The work itself could be finished without the intervention of the system. Under the new system, the work is incorporated into the system and starts with the data entry into the system. In negotiation, data entry was conducted after the delivery to banks. Now it is performed before it.

Table 4
Changes in the six temporal dimensions

	Export L/C advice	Export licence	Local L/C	Negotiation
Duration	(+) data entry reduced from 3 times to once, and 80% of data already put in by banks	(+) some paper work reduced	(+) some paper work eliminated	(+) duplicate data entry removed
Sequence	( ) steps reduced from 6 to 4 by the removal of data entries, yet the basic order remains unchanged	(+) data entry fixed at the first step of the whole process	(+) data entry fixed at the first step of the whole process	(+) data entry for negotiation shifted from after the delivery to the banks, to before it.
Temporal location	(+) fixed collection time ⇒ collection done when necessary	(+) irregular, sporadic ⇒ fixed (company A); fixed ⇒ whenever necessary (company B)	(+) spreading throughout the whole afternoon (in the assisting team) ⇒ specific times of the afternoon	( ) no difference
Deadlines	no deadline	(+) no deadline ⇒ three set times arranged as deadline (company A); rigid deadline ⇒ no deadline, processed whenever necessary (company B)	(+) deadline loosened	( ) the same deadline remains
Cycles	(+) order cycle reduced from 7 days to 1–2 days; as a result order cycle converging with worker cycle	(+) shortened from half a day to 1–2 hours; worker cycle and order cycle converging	(+) order cycle reduced from 2 working days to 1 day; worker cycle and order cycle converging	(+) batch cycle shortened
Rhythm	( ) even and flat	( ) the same rhythm	(+) evenly, flatly busy ⇒ stress emerged (assisting team)	( ) only a slightly little difference found

4.3. Temporal location

Tasks are usually not conducted at random points of time. They tend to be carried out at specific points of time either customarily or by some technological restraint. A new technology system employed by an organization can shift temporal locations of some activities. There are two possibilities, which are in complete contrast: the new technology may release those activities from temporal restraints imposed upon them so far, and conversely it may impose new restraints on them that they become tied up with newly designated specific points of time.

As seen in Table 4, temporal location was affected in the three domains except negotiation. The two directions mentioned above are found. First, some tasks which have been performed irregularly and sporadically throughout the day are now being processed regularly at fixed times of day. They are E/Ls in company A, and local L/C in both companies. This shift gives regularity to the workers in charge, which means the possibility of keeping a schedule, at least as far as the task under their charge is concerned. Interestingly, the second direction is the opposite. Some tasks which have been conducted at fixed times are now being performed at unspecified times or whenever necessary. They are export L/C advice, and E/L in company B. This also raises the possibility of scheduling work especially when tasks can be done at the will of the workers in charge or whenever they are necessary. The shift of E/L procedures is noticeable. Before KTNET was implemented, applications for E/Ls were made irregularly and sporadically. After KTNET was introduced in company A, the temporal location for E/Ls became fixed. In company B where KTNET is developed to an advanced form, they take place whenever workers in charge want them.

4.4. Deadline

Contrary to general expectation, deadlines are not universal in all tasks. In export L/C advice, no designated time was found which can be called a deadline. Although the principle of 'the faster, the better' was taken for granted, there was no deadline specified formally.

The impacts of KTNET on deadline are various as seen in Table 4. In negotiation, the existing deadlines remain unchanged. In the process of local L/C, rigid deadlines loosened. The loosened deadline was accompanied by some changes in social relations among the workers involved. This will be discussed in the following section. In the processes of E/L in company A, a new deadline emerged. In company B, the old rigid deadline in E/L disappeared, so it can be processed at any time whenever necessary.

4.5. Cycle

It was found that we could distinguish three separate cycles involved with one job. Workers do their duties or activities on the basis of, typically, a 1-day cycle. In each job, there is also a cycle in which a single order is processed from application

to completion. Finally we can find a cyclical period during which orders are accumulated and processed in batch. We call them 'worker cycle', 'order cycle' and 'batch cycle' respectively. They are not always apparent together in each job. Two or three of them are found in some of the jobs examined in the fieldwork.

In processing the local L/C, we can find order cycle and worker cycle. The former is the time required in completing one specific order (steps 1–12); the latter is the cycle of workers' daily activities. Previously, the order cycle was 2 days while workers in charge repeated the same job on a daily basis. Now the two cycles approximately coincide with each other.

In negotiation, we distinguish three different cycles. One is the cycle of one negotiation order being processed from arrival in the foreign exchange department to getting ready to be delivered to the accounting department. In principle it takes 3 days for an order to complete its journey. On the day when the order is received, it goes to the banks, and its bill returns the next day. On the 3rd day the bill gets signed and ready to go to the accounting department. This 3 day cycle is the target of the foreign exchange department. In practice it takes 4 or 5 days. The second cycle is one of workers' daily activities. Workers repeat the same activities on a daily basis. There is little difference in these two cycles before and after KTNET. The third one is the cyclical period during which negotiation orders are accumulated and processed in a large bundle. Previously bill workers kept bills collected from the bank in their drawers for several days, and handed a bundle of bills over to checkers on a weekly – or longer period – basis. In practice, towards the end of each month a great majority of orders came to checkers. Since the launch of the new systems, the cycle has become shorter. Negotiation orders are handed over to the accounting department more frequently than before. As a result, the tendency of work being concentrated towards the end of the month has been alleviated.

In summary, Table 4 shows that cycles of all the jobs are affected. All the cycles have been shortened as anticipated. Partly as a result of the reduced cycles, cycles in each job are coinciding. As seen in Fig. 5, information technology tends to make two or three cycles involved in a specific job converge with each other.

4.6. Rhythm

Rhythm is closely connected to cycle and deadline. We are not evenly busy while doing something. Just as there are rhythmic alternations of strong and weak stresses in music, we have alternating turns of busy and less busy periods in all the activities we are doing. As shown in Table 4, rhythms in the four domains are rarely affected by KTNET. Only for assisting teams in local L/C is a small change found. Before KTNET, they were evenly and flatly busy throughout the afternoon. There was no point of stress. Presently they are busy at the specific times of the afternoon when they send applications and receive the local L/Cs. There emerge rhythmic stresses. Because work rhythm is more influenced by external factors surrounding companies than by internal factors such as technological innovations, it is inferred that the impacts of KTNET on rhythm are minimal.
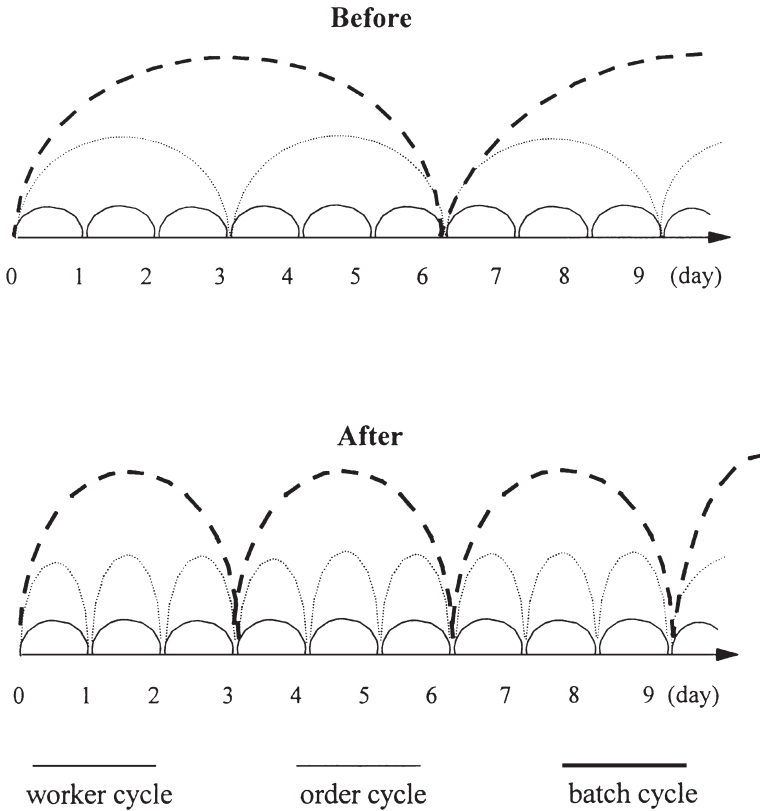
Before

After

worker cycle   order cycle   batch cycle

Fig. 5.   Converging cycles.

4.7. Summary

As shown so far, KTNET has affected the six temporal dimensions of the four major domains in export work, although not all of the six dimensions and not all the domains are equally affected. As easily anticipated, duration and cycle are considerably reduced. In the dimension of cycle, not only the reduction but also the tendency of converging cycles was found. Another dimension that is remarkably affected by KTNET is the temporal location. Under the new system, some tasks of the four major jobs are performed at different times of day from the previous ones under the old system. Among the tasks of which temporal locations have shifted, some are now conducted at specified times agreed upon by the parties concerned, and others are at unspecified times when it is necessary to perform them. Where deadlines exist in completing the jobs, they are also affected. Although it is early to conclude, a tendency is observed that the more advanced the information systems are, the less rigid the deadlines become. Sequence is modestly affected. Rhythm is the least affected dimension.

5. Temporality, work and social relations

We have described the changes in the temporal dimensions since the implementation of a new information system in the case study sites. One of the motivations from which this study stemmed is that their effects are not limited to temporal changes themselves in business processes. They may have extended implications for the organization that has adopted the new system. During the fieldwork, we found several points worth noting for their implications for work and social relations.

First, we have seen an occasion where the temporal pattern of one department affects the pattern of another one that is adjacent in the workflow of export processes. This limits the temporal potential of information technology. As seen before, there are three cycles in negotiation. The workers in charge repeat the same activities every day (the worker cycle). Each negotiation order gets signed and transferred to the accounting department in 3–4 days from the day it arrives in the foreign exchange department for negotiation (the order cycle). However, this only applies in principle. In practice, negotiation bills are not delivered to the accounting department on a daily basis. Before KTNET they were dealt with on a 10-day or longer basis (a batch cycle), and the majority of them usually remained in bill workers' drawers until the deadline day set by the accounting department came. The workers in charge of the negotiation bills were so busy that they were not able to process them properly on a daily basis.

More importantly, however, the accounting department itself did not want to receive them every day. The department runs on a monthly basis. Its main duty is to produce monthly reports and an annual report on financial accounts. All the activities of the accounting department are organized based on the monthly cycle, and rigid deadlines are set around the last days of each month. As for the workers in charge of the negotiation bills, what is important is to keep these deadlines, not to observe regulations that stipulate the 3-day processing. They exist only as recommendations and in principle. Therefore, there was a big gap between order cycle and batch cycle, and a great deal of work concentrated toward the deadline, the last days of each month. This has already been noticed by Schriber (1986), although in her study the accounting department is described as "constrained by the cycles of other department" rather than constraining them, which is the case for the negotiation in our study.

> The temporally bounded task cycle framework can be extended to the scope of the entire organization. Functional work units within organizations might each have their own rhythm based on the mix of internal and external connectedness, related goals, and defined responsibility. (…) On the other hand, the accounting department of the same firm is constrained to a greater extent by artificial cycles. Among these are the necessity to report earnings and pay taxes on a cycle dictated by the government. Unfortunately, the accounting department is also constrained by the cycles of other departments in its organization, such as the forestry department. One can imagine that the accounting department experiences work overload

when the meshing of various differentially determined cycles converge to exceed the temporal resources available (p. 33).

The introduction of KTNET provided the possibility to fill the gap and evenly distribute workload across the month. In fact, KTNET shortened the batch cycle to about 7 days and alleviated the extent of job concentration on deadline days. However, it is far from what would be expected from the new technology. On this occasion, the rigid monthly cycle of the accounting department restrains the temporal potential of KTNET. This also shows the potential of the temporal analysis as we executed it in this study. If the developers of KTNET in the companies had been aware of the different cycles running in co-operating departments and their possibly negative effects, they might have been able to design a different type of system which could deal with them.

At the beginning of the paper, we introduced Barley (1988) as a pioneering work on temporality and computers at work. In his study of hospital radiological departments, the new computer-based equipment increased the monochronicity by restructuring the external aspects of temporality, which led to the symmetry of temporal organization between the two professional groups concerned. Our case study also shows similar shifts in temporality of mono- and polychronicity and temporal symmetry (Lee, 1999). However, to pronounce clearly which temporality, mono- or polychronicity, information technology tends to facilitate and whether it will always create temporal symmetry, more research is required.

Barley (1988) not only investigates how technology affects temporality at work, but also explains how technology affects social relations at workplaces through temporal parameters. It is in his contribution that he first approached the latter question from the temporal perspective. In the radiology departments, the temporal symmetry made by the new computer-based equipment decreased conflict between radiologists and technicians, and changed the social relationships between them. The new relationships are marked by greater equanimity and less conflict between the two professional groups than existed previously under the previous x-ray systems.

Our study has also assessed changes in social relations triggered by the new EDI system. In the procedures of local L/C, we showed that the rigid deadline became less rigid. Business departments had to submit local L/C applications to the assisting team before 11:00 h under the manual system. Because there was much work to do on the side of the assisting team after it received the applications, it was important for business departments to meet the deadline. The local L/C workers in the assisting team repeatedly urged them to meet deadlines, which was a constant source of uneasiness between the two departments. The implementation of KTNET has reduced substantially the workload of the assisting team after they receive the applications electronically. Therefore the 11:00 h deadline is not as rigid as it was. For example, even when some applications arrive after 11:00 h, the workers in the assisting team can process them properly on the same working day. As a result, the workers in charge in the assisting team do not press business departments to meet the deadline as they did, which means that a source of conflict between them has disap-

peared. "My position toward business departments has changed from urging to help-
ing", said a worker in the assisting team.

   In summary, the less rigid deadline in the procedures of local L/C has affected
inter-personal or inter-departmental interaction. When the deadline was rigid, work-
ers in the two teams were hostile to each other. While workers in business depart-
ments often lagged behind the deadline, the assisting team urged them to meet the
deadline. Now they are not hostile to each other, but cooperative. The workers in
the assisting team try to help rather than urge. It is difficult, however, to conclude
at this stage of our research that changes in temporality always bring such changes
in social relations among the parties concerned. Similar occasions were not found
in the three other domains investigated. The issue of temporality and social relation-
ships also requires further inquiry.

6. Conclusions

   Time has not been explored well enough in information systems research or in
management studies, considering its fundamental importance in organizations and
society. When it comes to a particular question which this paper has addressed, that
is, how information technology affects temporality, the simplistic answer is usually
given that information technology has accelerated the speed of work at an enormous
rate and saved organizations a great amount of time. The motivation of this paper
was to go beyond this simple answer and show how a deeper consideration through
analysis can provide further understanding of the issue of time and information tech-
nology. We have developed the temporal dimensions to describe and analyse tem-
poral changes in business processes caused by a new information system. We also
conducted the case study of KTNET, through which we have attempted to provide
a detailed account of the relationship between temporality and information tech-
nology. It helps us to understand patterns in which information technology affects
temporal order at workplaces.

   By devising and connecting the temporal dimensions, we have tried to show the
temporal profile of the work examined other than by simply depicting 'when', 'how
long' and 'how fast'. Despite our effort throughout the research to distinguish the
temporal analysis attempted in this research from the typical clock time analysis, we
are not able to be completely free from the notion of time that is embedded in both
the subjects and the investigators, ourselves. In this research, the temporalities were
not described using the standard unit of the second, minute and hour. They were
presented by the subjects' own language. If they used the hour in describing their
work, we followed. If they told of their time using such terms as "after lunch time",
"in the morning" and "half a day", we employed them.

   As noted previously, Barley (1988) distinguishes between the structural and inter-
pretive aspects of a temporal order. Structural attributes are external aspects of a
temporality such as the six dimensions that were investigated in this paper. Inter-
pretive attributes are concerned with people's perceptions on those external aspects.
While this paper has been partially successful in examining the externality, the inves-

tigation of interpretive and psychological aspects has not been attempted. For more intensive and comprehensive inquiry into both structural and interpretive aspects of changing temporality in organizations, an ethnographic study is recommended.

According to Hassard (1996, p. 596), temporal structuring is at the heart of organization and therefore temporal factors should be of primary concern when organizations are designed or changed. The neglect of temporality has perhaps hindered our understanding of information and communication technology initiated organizational changes such as virtual organizations in which time, along with space, is a key element in their transformation. Therefore, temporal factors should be taken into account when we design, develop or implement organizational changes, particularly ones facilitated by information technology.

Nowadays, the Internet adds a novel dimension or complication to our understanding of time and temporality at work. How is people's perception of time transformed by the Internet? How do people organize their time at work in the face of virtual organizations, virtual teams, distributed work, etc? How is their view of the world surrounding them, especially of their work world, changed? How different is it from the views of previous generations? These are only a few of the questions that need to be addressed by further research.

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