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# Work as the Making of Time and Space

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**Abstract**
An ethnographic study of a globally distributed e-commerce software development team reveals how the doing of work necessarily involves the shaping of space and time. Software development work is composed of multiple work elements, each of which has a characteristic number of aspects or steps that must be performed, as well as a characteristic number of communicative relations which must be maintained. Individuals on the software development team have multiple work elements that they attend to concurrently, by rotating their attention among various elements, much as a juggler keeps multiple objects in the air. Our observations of this distributed team show how the work of software development proceeds by selectively opening or closing space in order to experience a different pace of time. In this way, individuals construct a space time continuum that enables them to successfully handle the number and type of work elements that they are concurrently "juggling".

**Keywords:** Time, Space, Distributed work, Virtual teams.

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# Work as the Making of Time and Space

## The Study

We report on an ethnographic study of work practices by an e-commerce software development team in a Fortune 100 Industrial Company (hereafter referred to as Electronic World) conducted from August 2000 to February 2001. The team was globally distributed with members in the United Kingdom, America and India. Our observations and interviews took place in the American office and included continuous presence during working hours for six months, as well as meetings with workers off site and after hours. The American office was the location of the core team members, numbering five, with two shifts of contract programmers in India, and four active members in the United Kingdom, with Marketing users from throughout Europe sometimes included in teleconferences. The project task was to create and integrate a global e-business catalog platform to support various classes of users ranging from end-consumers through large retail customers to the internal sales force and engineers.

## The Setting

The E-Catalog core team was located in the northwest third of Electronic World's major division's e-commerce room. The e-commerce room for the division had been created in 1999, when management tried to establish a modern Dot Com organization within the historic flagship division of the corporation. Small offices located in the southeastern corner of the second floor of the division's main Information Systems building (pre-World War II) were gutted and ripped out. A large, bright, airy room was created. It stood in stark contrast to the long, narrow low-ceilinged 1950's hallways and offices that made up most of the division's headquarter complex.

The e-commerce room was rectangular in shape except for two corner areas that had been carved out. A small square area had been removed from the northeastern corner of the room to create a front entrance landing area by the building's main elevator and stairs. From the landing, a pair of glass doors opened into the reception area of the e-commerce room. Modern leather chairs were placed on either side of the doorway. To the immediate right of the reception area, a small round bar and barstools lead into the large center open area of the room, which ran diagonally to the southwestern corner. In the northwestern corner of the room a rectangular area had been walled off to create a large glass fronted conference room with vertical white blinds. The walls of the main e-commerce room were painted white with the exception of the muted red stub walls framing the front entrance glass doors and the avocado green west back wall and stub walls framing the conference room. The suspended white ceiling for the room was split into a moderately high 12 feet area along the interior walls of the room and a higher 16 feet area in the center of the room. This higher section extended to the eastern and southern outer walls of the room where sunshine was able to stream in through the tall multi-paned early 20$^{th}$ century windows.

Low divided cubicles formed three side aisles running parallel to the main open area of the e-commerce room from northeast to southwest across the room. A rectangular flat black steel frame created an open-walled conference room with an oval table in the center open area of the room. The northeast side of the open-walled conference room was formed by a black shelving

unit with a high quality stereo sound system while the opposite end wall was created by a large whiteboard. The other two sides of the 12-foot square open conference space remained unobstructed most of the time. On rare occasions, muted yellow curtains were pulled across the black frame on one side or the other of the oval table to reduce visual distractions for people meeting at the table or for people located in the nearby open-sided cubicles.

Not only did the colors, light and furniture coincide with the stereotypical idea of an American Dot Com company, but the individuals did too. Approximately 25 people working in the room, their median age about 27. Almost all of the people in the room were under 32 years old. There were three notable exceptions: one man was in his sixties, one youthful fit forty something man, and one easygoing fairly trim woman in her low forties. The five or six people in the room in their mid-thirties for the most part had masters' degrees and without exception were physically fit and energetic. The ethic background of the people in the room represented a cross-section of the U.S. - African American, Latin American, with the largest portion being white-Caucasian. A significant number of people working in the room were from the Indian subcontinent, the majority of which were contracted computer programmers and technicians with a couple being World Electronic employees. A couple of contracted American computer programmers also worked in the room. Although a few people working in the e-commerce room were from both the American East and West Coasts, in general people exhibited a friendly down to business Mid-Western attitude towards work and each other. During typical weekday office hours, people dressed in business casual.

## The Findings

Based on our observations at Electronic World, we conceptualize the software development work that we observed as being composed of multiple work elements, each of which has a characteristic number of aspects and relations. By aspects we mean the number of separate issues, steps, sub-problems or 'pieces" of the defined work element that the individual was working on. By relations we mean the number of communication or coordination linkages that the person maintains in order to perform the work element. Individuals at Electronic World have multiple work elements that they attend to concurrently, by rotating their attention among various elements, much as a juggler keeps multiple objects in the air by rotating attention among them. Work in software development teams shapes time and space as the individuals reconfigure their immediate time space continuum in ways that enable them to successfully handle the number and type of work elements that they are concurrently "juggling".

In order to better focus our conceptualization of how workers shape and reshape their time-space continuum, we will pay close attention to two extreme types of work elements: those that are high in number of aspects but low in number of relations, and those that are low in number of aspects but high in number of relations. Work elements that are high in aspect but low in relations are internally complex, but relatively self contained problems that an individual must work on, such as developing a coherent set of specifications for a functional portion of the software system. Work elements that are low in aspect but high in relations are those that are rather low in complexity, but require coordination with several other parts of the overall project, such as making sure that one part of the software linked properly with another or that a data base was kept up to date. Our discussion will primarily concern these two types of work elements

(high aspect – low relation and low aspect – high relation) because it will allow us to lay out the basic framework for understanding how work is the dynamic reshaping of time-space. Later, we will discuss how more "mixed" forms of work elements, with different aspect – relation characteristics, are dealt with by team members.

We further conceptualize work elements as taking place in a field of work, which is both physical and virtual. The physical field of work is the rooms at Electronic World Headquarters where the team is located, and the virtual field is created by communication technologies such as email, groupware, telephone, teleconferencing, and online chat facilities. We see workers as reshaping their time-space continuum by taking actions that open or close the space in their work field, which in turn enables a speeding up or slowing down of time. It is difficult to express the time-space relation by talking of either time or space separately, since the two are only experienced together in a time-space continuum. Nonetheless, it is analytically helpful for us to consider that reshaping of space is the primary tool used by these workers in changing their time-space continuum. Space, whether physical or virtual, is what the workers have "at hand" and malleable to act upon. Although time is also an enactment, we choose to characterize the individual as acting primarily to reshape space in order to have a different opportunity to enact time because that seems to be the way that the individuals themselves think of it.

Given the above, we see these software developers as taking actions to open or close the space of the work field so as to enable a speeding up or slowing down of time. We see the opening of space as associated with an increase in the "speed" of time, and a closing of space as being associated with a "slowing" of time. Again, we are relying on the workers experience of time flying versus time dragging in using this characterization of speeding up and slowing down. First, we will consider how low aspect, high relation work is associated with a reshaping of the time space continuum that results in an opening of space and a speeding up of time. Recall that workers were located at workstation in a large open room. As they encountered work elements that required higher levels of relation, they would act to open their space and communicate across the room to others as needed.

**Opening space and accelerating time for low aspect – high relation work**

There were many low aspect - high relation interactions that occurred between members of the e-catalog team sporadically throughout the day. When members would work on data files containing product information to be placed in the e-catalog, for example, a team member would occasionally yell across the room to another team member who they were passing a file off to saying words like: "I put the file X in folder Y on server Z". The other team member would yell back "I got it" or "I don't see it". If people were working on a data file by themselves and encountered a problem that they could not solve in a few seconds or as long as few minutes, they typically would yell across the room to the person who had set the file up or who had last been editing it saying "I don't see field(s) X or a value(s) for field Y for product Z". The other person, if at their desk and not on the phone, would typically yell back the answer to the other person's question. Even if the intended recipient was at their desk and not on the phone, the answer back might be delayed if the recipient was helping another person with a more urgent problem or in a discussion with an important person from outside the e-business area. Sometimes a response did not immediately come forth because the recipient had their headset on and was listening to music

to drown out the conversational noise in the room. Such delays in obtaining feedback, although usually only lasting from 2 to 5 minutes, seemed like a long time to the waiting party. Short outburst interactions like the generic types just described would usually last no longer than a minute or two at the most and consist of no more than three or four short one sentence volleys back and forth.

When the sender could see that the receiver had their headset on, the male senders would frequently grab a stress ball or a porcupine ball and wing it at the recipient aiming to either hit their body or land in front of their face in order to get their attention. The recipient would look up and try to figure out who it came from, the sender would remain standing or leave their arm in the overhand pitch position to indicate that they had thrown the ball and the two would then start their dialog.

These short duration fast pace volleys were typical of e-catalog team communication when members were working in their respective cubicles, and although their relative frequency was fairly high, they were clustered overtime. Thus, it was not uncommon for the e-commerce room to be relatively quiet with a low volume of talking for a while, but then all of a sudden several separate conversations on different topics would start up all at about the same time. This made hearing ones conversation partner difficult if not in immediate adjacent. When this occurred team members instead of yelling over other conversations would call up the other team member on the phone to talk to them. The knowledge transmitted between teammates during these conversational relations tended to be small incremental amounts but substantial enough to provide the information and knowledge required thus allowing people to usually perform their low aspect job tasks.

On rare occasions, a team member would not comprehend what the person had advised or instructed. This would either result in the asking party either coming over to the person providing the solution or the asking party requesting the other person to come over and take a look at what they were trying to do.

The verbal fact-to-face (non electronic) interaction activities of team members when working from the individual cubicles tended to center on 1) figuring out how information or system components fit together, or 2) what piece of data or data object was missing and how to find it or complete it. Thus, it seemed like the knowledge gained tended to be incremental and of low aspect but high relation. The pace of this type of interaction was sporadic but frequent and is the main basis for our characterizing their handling of multiple work elements as a kind of juggling. An individual might be on the phone with one person waiting for a reply to a “look up” type of question while they were also yelling across the room to another person with a different question, and might also be keeping an eye on the online line chat box on the computer monitor where she was maintaining another conversation on yet a different work element.



**The experience of time speeding up and slowing down**

Time flies in an open space when multiple simultaneous work elements are being juggled and it slows down in closed spaces when engaging a limited set of work elements with high complexity. Most of the software development team, who juggled many low aspect – high

relation work elements, felt that time was flying by very rapidly. Any delays or periods of time waiting for another person, even if only for a half a minute, seemed exasperating long. Hardly ever did those people say that the morning or afternoon just seemed to drag on forever. In contrast to the majority of workers, some workers had jobs that involved high aspect but low relations, and those workers were, in a sense, closed off even in an open room. For them, time seemed to “drag”.

A good example is Evet - the e-commerce organization's sole in-house graphics designer. Her work primarily consisted of creating various graphic images (symbols, tab tags, etc.) or editing various image files (product images, picture or graphical images) used to make web pages more visually appealing. She would sometimes remark to other e-commerce members part way through the afternoon "doesn't this afternoon seem to be dragging?" The response from the other team members were words to the effect that they had been too busy with task X to notice. It wasn't as if Evet was not busy, or was not ever pushed for time, she was. However, Evet's work required a great deal of eye-hand coordination in editing image files. Editing or creating just one file could take anywhere from a few hours to over a day. Her interactions with the other team members usually consisted of 1) initially discussing the basic appearance desires of images before editing an image was started, 2 having an evaluative discussion of the appearance of the image or where it was located after Evet had a version of the image done and wanted to give it to the requesting party or wanted their feedback, or 3) when Oliva had a question about working with a non-routine product image file that was to be placed in the Image Bank or to be sent to a customer.

The other person who on rare occasions thought that time seemed to drag on was Robby - the sole American contracted computer programmer. Robby, was usually assigned work by Luke - the IS Team Manager. Robby's interaction with e-catalog team members usually consisted of asking Luke technical questions on how the computer script/program objects he was building or working should work or where he might find another computer object that he was needing in developing or testing the script or program he was working on. If the program Robby was working on directly related to another programming task that Amene or Seth was working on, Robby might directly interact with them instead. Robby's sense that time was dragging seemed to arise when: 1) he was waiting to get a piece of Luke's time to go over some technical issue or get a short answer to a question such as where to put a file, or 2) he was reading software or programming documentation trying to figure out how to do a certain process or activity using a particular computer language or software package but not finding the information he needed to complete the program or routine.

On very rare occasions, Oliva who was in charge of the division's electronic product images would grumble about time dragging. This seemed to occur when she had been working multiple days in a row on reviewing, formatting, and moving image files and there was not an immediate deadline within a couple of days and the rest of the team was not needing to interact with her at the time. Once again it was not that Oliva was not busy and had work to do, it just seemed that during those periods of time, her level of interaction with other team members was drastically lower than normal and the work she was doing was very routine and not mentally challenging her. Note this pattern in which work that is high aspect and low relation is experienced as time

dragging, whereas others workers who juggled more low aspect and high relation work felt time was moving quickly.

Karl, Luke and Seth almost never seemed to grumble or remark about time going slowly. All three of them had relatively high levels of interaction with people both within the e-catalog team and e-commerce area, and also from outside the e-commerce area. Karl's interaction with outsiders usually consisted of discussing e-catalog capabilities and desires with the various functional user groups of the e-catalog system and the owners of the data to be placed in the e-catalog (product managers, marketing product line mangers, and sales representatives). Luke's interaction outside the e-catalog team was split between other e-commerce developers on other teams on discussing technical functional and usage issues related to the various e-commerce products and tools they used in common and network and database administrators in charge of the servers and databases upon which the development, test and production versions of the e-catalog was running. In essence, Luke had frequent regular outside interactions that were required to keep the systems up and going and allow the programmers and developers to make progress in their work. Seth's outside interactions were also usually split two ways - one was with the functional users who were providing specific data information to be placed in the catalog or wanted specific features and the other was with the offshore team discussing specific e-catalog project requirements. When portions of the e-catalog system were ready to be moved to the staging or production areas on the computer servers, Seth's level of interaction with database and server administrators would increase.

**Higher aspect work requires space to be closed off**

When the work elements an individual was engaged with were of higher aspect and lower relation, they would take steps to close off the space in their field of work. It appeared as if Karl, Luke and Seth each had different strategies to try to set aside blocks of time with relatively few interactions interruptions. Luke's general approach was to come in early - frequently he would come in at 6:30 or even as early as 5:30 AM during which time he tended to go through his email and work on challenging/tricky technical problems and bugs.

Karl tended to schedule meetings with functional people or team meetings either in the midmorning 9:00 to 11:30 or late afternoon 3:30 to 5:00 PM thus leaving the early afternoon open after returning from his noontime run and while munching on his monster salads. During these early afternoon periods, Karl frequently tended to focus in on editing complex data spreadsheets that were to be loaded into MS Access and eventual into Oracle for the e-catalog. While editing these files, Karl seemed lost in thought with his focus and concentration broken only when interrupted by a person trying to communicate with him, an unexpected noise in the room, or when the data in the file was missing, incorrect, or did not match the models and rules for the product data based on his twenty plus years work in Marketing with Product Managers. Seth's apparent strategies to create uninterrupted blocks of time were to work late, come in over the weekend, or to go into hiding in one of the conference rooms on the second floor. Frequently even when working late and on weekends a person would find Seth working in a conference room by himself. Typically what he did during those time periods was to develop pieces of computer code or write detail specifications to give to the contracted programmers both on and offshore.

Oliva's attempts to reduce interruptions usually centered around her putting on her headsets and listening to music that covered up the conversation and sound of the movement of people around her cubicle. Plus, having the headset on tended to discourage visitors from asking her directions when they entered the e-commerce room. Since Oliva's cubicle was the first cubicle to the right of the reception area by the front entrance, she had the noise and visual distraction of everyone walking past her cubicle. In an attempt to block the visual distraction and reduce the noise, she placed tall books and other objects on the overhead shelf to her right thus increasing the effective height of the cubicle wall between her and the reception area. She also did the same with objects on the shelf in front of her, which was between her and Billy who "talked loud". The more tall objects Oliva had on the shelf between her and the reception area the fewer the questions she seemed to receive from visitors entering the e-commerce room when the receptionist was not at her passthrough located directly in from the double glass front doors of the e-commerce room. Frequently, even when the receptionist was at her desk visitors would automatically walk towards the right and the open center area of the room and then stop when standing by Oliva's cubicle and turn and ask her questions. This, phenomena happened even more often when the receptionist was doing paper work at her desk so that only the top of her black hair was visible to visitors coming through the doors because the passthrough was at nose level even when the receptionist was looking straight ahead.

These individual strategies for closing space in order to have more time had a corresponding group equivalent. In planning sessions, for instance, those involved in a particular part of the project being planned would gather in the main conference room. The vertical blinds for the glass wall tended to be closed if darkness was needed to make a computer projector "proxy" screen image easier to read. They were also frequently closed when people wanted to really focus on the meeting and not be interrupted or when the meeting was somewhat political or confidential in nature. The blinders where typically left open if the meeting involved virtually everyone in the e-business area and darkness was not required for projected screen images.

These planning sessions would typically follow the agenda of the person coordinating/calling the meeting. If one of the participants felt that they may need to leave before they thought the meeting would get over, they would ask the person when they thought it would get over and then explain their time constraint. Frequently then the agenda schedule would be shuffled to allow for the constraint. Sometimes however, a participant would part way through a meeting decide that they would have to leave before it was over. In which case, at a natural break in the discussion, they would share their constraint. The discussion then usually would change to the issues for which the constrained person was needed. If however time would not permit an adequate discussion of the topic, it would be tabled till a later meeting or taken care of by a follow up phone call or breakout meeting session.

**Being “grabbed in” to a closed space**

On occasions a project team meeting in the main conference room would during the course of discussion realize that they needed the opinion or knowledge of a person not in the room. Typically one of the people setting closest to the glass wall and blinds would peer through the blinds in an attempt to spot the needed person. If the needed person was spotted, one of the people sitting or standing next to the door would stick their head out the door and yell, signaling

the needed person to come in, which they usually obliged if they were not tied up with a more pressing issue. People who were grabbed into a conference room meeting typically stayed in the conference room until the meeting was over unless they had a really pressing issue to attend to. It seemed as if the person that was brought into the room usually became an integral part of the ongoing meeting or was compelled to stay because the topic discussed interested them or they felt that they might be needed later in the course of the discussion. The way that individuals who were "grabbed in" to a meeting in the conference room tended to stay for the duration suggests to us that the experience of time did indeed slow as the space was closed.

Smaller groups of workers who had high aspect but low relation work elements were also conducted in more closed spaces. There were two locations that seemed to be preferred by these employees when trying to focus on complicated technical tasks. The favored one was the small Conference Room B which was located in the back hall near the back pair of restrooms and right next to the small break room (with the refrigerator, free pop, coffee, water, microwave, futon and futon desk). The Second location was the large glass walled conference room.

Conference Room B, had a heavy wooden door with a small frosted glass window in it. Looking through the glass you could tell if the lights were on in the room, but you could not determine if there was anyone in the room. People tended to sign the room out about half of the time when working alone in the room on technical tasks. Since there was a shortage of meeting space, individuals working by themselves in the room showed great flexibility when groups wanted to use the room. Therefore by not signing out the room and leaving when someone else asked to use the room for a meeting, the individuals were not perceived to be selfish.

The scope and detail level of project specifications that were to be worked on determined how many and which people were asked to be at project specification planning meetings. Typically high-level project specification/planning meetings were held in the main conference room with large percentages of the project team present. Development of more detail oriented project specifications was generally undertaken with just a few people involved. Meetings developing and discussing those specifications where held in locations depending upon who was involved, whether additional people might be needed for the discussion and what meeting space was available during the mutually unreserved time slot of the participants. However, when it came to writing up and spelling-out the actual specifications in particular the very detailed project and programming specifications, typically those specifications were written by an individual working alone or with at most one other person.

When team members such as Seth would work on writing specifications, they tended to go into an empty conference room. Seth's preference appeared to be the small Conference Room B. He all most always closed the door most of the way - just leaving it open a crack. There he would work in silence for hours at a time typing the specifications into his notebook PC. Occasionally, he would glance at a few pieces of papers that he would bring into the room and spread out somewhat to either side of the notebook PC. Seth generally positioned himself so that he had a large amount of space free to his left or right on the table and in a direction where moving visual distractions would not occur (back to the doors or glass walls). If the material on the whiteboards related to the project specifications Seth was writing about, he would sit facing them straight on. His slouched leaned back with legs and feet extended forward posture let him view

the notebook's screen straight on. This strategy was also taken by Luke with the only difference being that he preferred the main conference room to smaller room B and that as an IS team leader he wrote fewer specs and primarily those at a higher level. Thus Luke was seen hiding less frequently and for shorter durations. Nonetheless, the pattern seems to be that high aspect - low relation work elements are related to a closing of space and a slowing of time.

During the course of the catalog projects, the team would occasionally schedule meetings in the conference rooms to go over complex project issues. These meetings typically would last over 90 minutes and involve anywhere from two to four people depending upon the topic being focused on. The meeting room of choice appeared to be small Conference Room B. Second choice for these meetings was the main conference room. If that was not available, one of the other conference rooms in the building was used. Never during the course of the projects did the researchers observe long complex interactions undertaken between regular employees of the same type (information systems or functional) at their desks (cubicles/workstations) during normal business hours. If a complex conversation seemed to arise between two functional people or two IS people, they would try to grab a conference room or postpone the discussion until a conference room was available or they day had officially ended.

**Work elements in the midrange of the aspect–relation balance: Draw ins and drop ins**

Between the two extremes of low aspect - high relation work seen in the open office area and high aspect – low relation work seen in the closed meeting areas, there is a middle ground of work elements that are more moderate and varying in their aspect – relation ratio. As the individual juggles multiple work elements, some are encountered which require input from or coordination with others, but are of relatively short duration and not appropriate for a closed room session. These types of meetings would take place at the conference table in the center area of the open office. The conference table in this open area had at least three purposes. It provided a temporary work location for functional employees from other locations when visiting and collaborating with people in the e-business area. The second function was to be used as a celebration area where food would be placed during any lunchtime or end of the day celebrations. The third and primary function was as a meeting and/or collaboration location for people within the e-business group.

The open conference area with its oval table and whiteboard(s) was a convenient location for e-catalog team members to meet. Since it was close to their cubicles if they forgot or needed something else for the meeting, they could quickly retrieve the item. Plus, if they were expecting an important phone call or someone at their cubicle they could keep an eye and/or ear open so as to prevent them from missing an interaction that might slow progress down on another front. But more frequently it seemed, that during the course of meetings at the open oval table, a topic being discussed would require input, an answer to a question or additional information from an e-business person not initially included in the meeting. People at the table would scout around to see if the "needed person" or a substitute for that person who "might know" was at their cubicle or somewhere else in the open e-business room. If the "needed person" was located, one person at the table would typically yell out the needed person's first name and then hand gesture for the person to come over. It was fairly common for the American male employees to be yelled at by their last name instead of their first.

Once the person's attention was obtained, he or she would quickly come to the open conference room area and thus be "drawn in". Typically they would stand unless a person sitting at the table gestured to sit or said "pull up a chair" or "have a seat" which gave a signal to the person that their involvement in the meeting was not going to be a single short answer question or two. If the person asked to join came to the open conference area had something pressing about to happen back at their desk, they would give the reason that they couldn't stay or say that they need to leave once someone they were meeting with enters the room. If the drawn in person remained standing, typically the person who asked that that person to come to the table or the person running the meeting would tell the "drawn in" person "thanks that's all we needed you for now" and the "drawn in" person would return to their cubicle.

If the "drawn in" person could not immediately join in on the meeting they would usually give a hand gesture indicating that they acknowledge the invitation and would come shortly by raising one arm with the index finger extended. However, if they were tied up dealing with what they perceived to be more important, they either pointing to their headset, a visiting person, or their computer and then raising both hands upwards and outwards indicating that they didn't know when they would be able to join. Once, they finally did join in they typically gave a short explanation of their delay in coming if it was not visually obvious such as a visiting person.

If the "drawn in" person had to leave when a person arrived or the phone rang, they would position themselves facing the group at the table but where they could easily hear or see their reason for breaking away from the meeting. If the "drawn in" person got to rapped up in the meeting and didn't notice their guest arriving, the more comfortable their guest felt with the people at the table the closer the table their guest would come to get the attention of their host, the "drawn in" person. If they felt very comfortable with the people at the table, the guest would temporarily join the group at the table (but remain standing) and greet the people seated at the table. Sometimes, the guest would supercede the ongoing conversation with a short discussion or announcement to one or more of the people sitting at the table and then "snag away" their host and go back to the host's cubicle.

If the drawn in person took a seat, the conversation on the topic the person was drawn in for would be carried out. The person drawn in would typically not only answer the questions asked of them but also share their opinion on that topic and immediately related topics. Frequently, the original meeting group would in a sense forget that the "drawn in person" was not originally part of the meeting, this would lead to the "draw in person" speaking out and saying "Do you need me for anything else?" Members of the original meeting group would either pipe up with the other issues they want to ask the person or say words or gesture to the effect "no, you can go". Typically the American employees were quicker in asking to leave than the contracted Indians, who would once and a while end up staying to the end of the meeting if none of the original meeting group members would ask the question: "Do we need x anymore?" If the answer came back "no", then the contractor would leave, if the answer came back meaning "yes", the topic of discussion would shift to why that person was needed or at least be focused at getting to why that person was needed in the meeting as quickly as logical discourse on the topic would allow.
If the person needed for discussing a topic at the open conference table would not be visually sighted in the e-business area, discussion would shift to the next logically related topic where the "missing needed" person was not needed. At least one meeting group member would keep one

eye and ear open for the return of the "missing needed person", once sighted the spotting individual would yell at the missing person and gesture for them to come over and join the meeting. Discussion would then immediately revert back to the issues and topics the missing person was needed. Sometimes, a person needed for discussion of a topic would be a person who worked outside of the e-business area, if that person happened to walk by the open table during a subsequent part of the meeting, they would be asked to stop. Discussion would then revert back to the topic for which the person passing through was needed.

One of the characteristics of using the open conference room table was that not only could the group meeting members draw-in additional people to the meeting, but rather people walking by in the main aisle of the e-business are could "drop-in" on the meeting uninvited. A typical drop-in situation would be when a person who was walking by realized that they needed to tell multiple persons sitting at the table something or to give one of the individuals an urgent message. The topic the person walking by would raise usually centered on a change in status of an unresolved project issue they were mutually working on. The interjection raised by the drop in would usually begin in the form of an announcement dealing with 1) the obtaining of a data file, 2) the completion status of an important database load or program test, 3) a system crash, 4) the acquiring of critical new project related information, 4) the sharing of kudos for a recent team or individual accomplishment, 5) a critical personal announcement (person sick, birth of a baby, change of position, etc) and of course 6) the invitation to share in free food. Only the most urgent and critical announcements or the sharing of new critical project information would result in a lengthy change of subject for the group.

When looking at who typically did the "dropping in", it tended to be functional people passing through the e-business area with additional information on a project, a technical infrastructure person announcing a system's status, or a management person sharing kudos. Once and a while it would be an IS or functional team member - who appeared to have very carefully calculated dropping in on the meeting with the intent purpose of sharing some information which they had that might be helpful in the discussion believed to be going on or overheard. The dropping in person frequently seemed to be somewhat tense and sometimes appeared to be somewhat staging the drop in. Announcements concerning major system problems by team members on the other hand came across as urgent and unexpected and would instantaneously gain the heightened attention of group members especially the IS members. Typically major system problem announcements made by the IS members of the team (Marc or Seth) originated with a phone call or email from IS/IT infrastructure personnel such as system or database administrators. The system problem announcements coming from the functional team members, Karl and Oliva (more frequently from Karl than Oliva), tended to originate from phone calls or emails coming from the users of the systems in sales or Marketing or occasionally from the functional product owners involved in the project.

Overall it seemed as if the groups of team members in deciding where to meet, would select the open conference area if they anticipated needing to draw additional people into the meeting. It also appeared as if they tried to avoid using the open conference area if they did not want drop-ins and other unexpected interruptions such as lots of noise in the open e-business area. This was sometimes unavoidable if conference rooms with doors close by were all in use. The people planning a group meeting typically choice to avoid the open conference area if the topic to be

discussed involved individual performance issues or unexpected project delays that did not appear to originate from some unpredictable outside source especially if no additional people were expected to be needed.

Once again, we read these work elements of mixed aspect – relation ratios as indicating how adept the workers are at shaping their space-time continuum. In these instances, they give form to a semi permeable space in the center of the room that enables desired levels of relations for drawing in or dropping in, yet also gives them appropriate closure for slowing down time as required.

## Clocking around the globe

The e-catalog team was importantly a virtual one. The work practices we have discussed so far are based on observations at the physical site of Electronic World's headquarters. But a great deal of project work took place between the three sites in the UK, the USA and India. In this dramatically expanded workspace that is opened to include the entire globe, time indeed speeds up as our analysis suggest. But some strange consequences follow. It seems as if space being expanded to such a global scale reduces the individual's ability to understand the physical space and time in which the work is being done, and therefore misunderstand the work that is being done. To explore this anomaly in perception, we will first chart the extent to which space is expanded by communication technology in the global team.

The EU-catalog project spanned people working in three continents (Europe, Asia and North America). This meant of course not only were people separated geographically and physically but also temporarily. The standard work hours at the division's U.S. headquarters for the American portion of the team were from 8:00 AM to 5:00 PM Eastern Standard Time, the European Team in the UK from 8:00 AM to 5:00 PM, and the contractors in India one of two shifts - first shift 6:00 AM to 2:00 PM and second shift 2:00 PM to 10 PM. Effectively this meant that during the summer daylight savings period the second shift people in India would be working until 12:30 PM American team time and 7:30 PM European team time. The first shift India people would be coming in at 8:30 PM American team time and 1:30 AM European time. The UK based European team would be working until 12:00 Noon American team time. This resulted in the standard conference call times between the North America and Europe team being between 9:00 AM and 11:00 AM American time and 2:00 PM and 4:00 PM UK time. The phone calls between North American team members and contractors in India typically occurred anytime from 8:00 AM until 12:30 PM American Team Time.

Thus, given the overlapping work times of the global team interesting work patterns emerged. It was not uncommon for a problem to arise during the conference phone calls from America to Europe in the morning. With these phone calls typically ending between 10 and 11 AM American time (3 and 4 PM UK time), the American team would then immediately try some problem-solving options if the issue(s) were anticipated to be quickly solvable. If the issues could not be quickly solved, the American team would outline the problem and a plan of attack and share it with the coordinator of the second shift of the Indian team who would have people work on the issue to the end of their shift. If the problem was urgent and still had not been solved by (12:30 PM America and 10:00 PM India), the second shift coordinator in India would

leave instructions for people working first shift India as to what had been accomplished and what high priority items needed to be done. If the first-shift Indian team was confused by the instructions, they were able to email, internet chat, or call an American team member (typically Seth) who might still be working at the office or at home during the first three hours or so of their shift (6:00 to 9:00 AM India and 8:30 to 11:30 PM America). Another problem-solving approach sometimes used was for the American based team to not inform the second shift Indian team of the problem and try to solve the problem by themselves. If the American team had not resolved the issue by the end of their day, they would email instructions to the first shift Indian team or contact them via phone or Internet chatting if it was in the evening.

Communication with the first shift Indian team appeared to be more difficult for the American team. This difficulty was sometimes attributed to the lack of overlapping standard work times. Another, factor possibly contributing to the perceived difference in easy of communication between the first and second shift Indian contractor team was that two of the second shift contractors had worked "onshore" in America as part of the American team during part of the project. Thus, the American team members felt that those contractors had a better grasp of the project objectives and vision for the e-catalog system than those that had not been "onshore".

Utilizing project team members around the globe, not only allowed the information systems portion of team more time for actually correcting a reported problem but also more time for investigate the problem and get team members up to speed on the issues and system features and complexity surrounding the problem. Therefore, learning curves of up to three or even four hours per shift team could be hid in the perceived two-hour end of day (overnight) problem fix time. This enabled the information systems portion of the team to stretch out time required to address a problem, but keep the perceived time to the functional/user portion of the project team relatively short.

The European team, consisting primarily of the functional and user communities, was usually unaware of the problem-solving efforts and communication undertaken by the American and Indian teams in response to their problem fix requests. Thus, the Europeans frequently saw problems they reported at 3 PM their time resolved by either 8:00 AM or 2:00 PM the next day - not realizing that during the intervening 17 or 23 hours 14 clock hours or even up to 23 would have been spent addressing a problem.

In essence, the Europeans quiet often perceived the problem as being only a two-hour fix (3 to 5 PM) instead of 14 to 23 hours. This sometimes led to gross misperceptions by the Europeans in the time required for fixing and addressing problems. For example the Europeans often perceived a problem reported at 1:00 PM UK time and fixed by 4:45 PM UK time the same day by the American team with maybe help from India as taking longer even though it maybe required 18 fewer clock hours of team member effort. Likewise, problems requiring 28 hours of clock to fix were sometimes perceived to take 20 times as long as one that required 23 clock hours!

The result of the dramatic under and over misperception of problem-solving time by the European team, meant that at times they were quiet satisfied with the efforts of the American team. However, at other times, members of the European team would be frustrated at the

Americans' apparent unresponsiveness or incompetence - consciously unaware of the deceptions of the clock and more urgent intervening issues that sometimes temporarily sidetracked the American and Indian teams' efforts.

## Conclusion

Our findings show how the doing of software development work unavoidably involves the shaping of time and space. Doing work is the shaping of time and space because the doing of work necessarily changes the workspace and thereby the possibilities for enacting a time-space configuration. As these workers shout across the room, throw stress balls to get attention, huddle briefly around a desk corner, retreat to the conference room, sit in the open area and invite draw ins and drop ins, they are opening and closing the space in which their work is performed, and creating the conditions for enacting a faster or slower experience of work time. As they choose different spaces to work in, they dynamically reconfigure the field of their interaction patterns and the landscape of time space within which they interact. Team members are seen as juggling the many simultaneous work elements that constitute their flow of experience and balancing the demands of the aspect – relation ratio in their different work elements by alternately opening or closing the space for their interaction. Work as the construction of time and space is thus a continuous accomplishment of their engagement with a stream of multiple work elements.

We also show how the physical space they are in is modified by their interactions and how it results in the speeding up and slowing down of time. We discuss how they create 24 hour global clocking with their work practices that results in a surprising relationship between the globally distributed team interactions and the local American team interactions. Local time-space differences matter more than global ones and require more innovation in work practices and more elaborate and complex interactions than those with globally dispersed team members.

The main conclusion of this study is that communication among team members is never just the sending of a message. They necessarily draw upon practices and technologies, which include changes in time and space as a central element in the communicative act. Choosing to work around a computer screen versus a piece of paper, for instance, is unavoidably a choice of time and space configuration for doing their work.
Workers employ familiar technologies like the telephone, email, scheduling systems and the internet in unexpected ways to open or close space and speed or slow time as they juggle their multiple work elements. Eye contact, shouting, making hand signals, and wearing headphones are all micro strategies for engaging time and space as they juggle these work elements. Similar to Bateson’s dictum that one cannot not meta-communicate, we find that these e-commerce development team members cannot work in time and space without reshaping time and space.

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