Unleashing Mobility in the Organization:  
A Time-Geography Perspective

Douglas M. Schutz  
Temple University  
dschutz@temple.edu

Yong-Young Kim  
Temple University  
Yongyoung.Kim@temple.edu

Youngjin Yoo  
Temple University  
Youngjin.Yoo@temple.edu

Abstract

The increased fluidity and agility of organizations demand the smooth mediation of information technology (IT) between user and task. As rigid hierarchies are giving way to open, loosely-coupled, mobile ways for collaborative business, mobility enabled by IT tools has been proposed as potential capability that can provide new dimensions in such mediation. But, few studies have provided an integrative theoretical framework on mobility. In addition, most studies have focused on either spatial or temporal dimensions of mobility, while ignoring the contextual dimension. In this paper, we propose a framework that is designed to capture the emergent impact of the use of mobile tools in the organization. It draws upon a time-geography perspective in building an integrated framework of three aspects of constraints on mobility – capability, coupling, and regulatory. The usefulness of the framework is illustrated using a case study on the implementation of mobile devices in the Center City District (CCD) of Philadelphia. The paper concludes with contributions and recommendations for future research.

1. Introduction

Advances in information technology (IT) are creating new opportunities in the realm of mobility which were previously unimagined. Organizations now have the opportunity for harnessing the increased mobility of people and tools. Business can be radically transformed using novel coordination methods and through the provision of digitally enabled services. Such transformation opportunities, however, are only fully realized when innovation requires more than going beyond simply speeding up existing processes. Implementing new technologies are also opportunities for organizations to reconfigure activity and coordination processes. These improvements, in turn, can dramatically enhance efficiency, performance, and the innovation of completely new value-added services.

The technology that can radically enhance mobility has arrived. Yet, its actual impact on the organization remains largely unknown. One of the challenges is that mobility is not a simple, uni-dimensional construct. Past studies have shown that mobility is a complex and dynamic construct with multiple dimensions [14]. Furthermore, these different dimensions of mobility encounter different constraints as people try to enact mobility in organizations.

This study seeks to examine the various constraints that organizations need to overcome as they try to implement mobile technology. Drawing on a time-geography perspective, we examined the three aspects of constraints on mobility – capability, coupling, and regulatory – on its three dimensions as defined as spacial, temporal, and contextual.

In what follows, we review past studies on mobility first. We then develop our integrated framework on mobility constraints. We then discuss the case study of the Center City District (CCD) in Philadelphia in order to illustrate the application of the framework. We conclude the paper with a future research direction and managerial implications.

2. Spatial, Temporal, and Contextual Mobility

Through the mass digitization of tools, mobility in the modern era goes beyond the simple physical movement of people from one place to another [14]. Technology artifacts designed to support mobility are in a sense becoming extensions of human beings. More tasks are performed faster and cheaper due to the compression of time and space through technology. Furthermore, computer-mediated technology can sometimes move space itself, enabling virtual teams to coordinate information independent of physical location.

Researchers have proposed various notions of mobility. Dahlbom and Ljungberg [4] describe three modalities of mobile IT use enabled by mobile technologies: 1) wandering which is localized mobility such as moving within the same office, 2) traveling which is moving from one geographic location to another as, for example, one does by driving a car, and 3) visiting which is temporarily being located at a site.
away from one’s primary office location, such as a consultant working at a remote, customer site for several days.

While useful, Dahlbom and Ljungberg’s framework focuses only on the physical mobility of actors. Therefore, as noted by Kakihara and Sorensen [14], “when considering the mobility, or more specifically societal mobilization, of human interaction, we need to deal with contextuality as well as spatiality and temporality, and, more specifically, mobilized situatedness of interaction in particular contexts and relations of social lives” (p. 5).

Kakihara and Sorensen [14] thus proposed an expanded view of mobility that consists of three dimensions: 1) spatial 2) temporal and 3) contextual.

Spatial mobility is the most basic dimension of mobility and is concerned with the physical movement of 1) objects or tools such as iPods, smart phones, and PDAs designed for nomadic users, 2) symbols in such forms as data, images, and audio files through such IT tools as the Internet, satellite TV, and smart phones, and 3) space through virtual teams enabled by IT.

One cannot move through a space without spending time, which brings us to the temporal dimension of mobility. The temporal nature of business has been widely recognized as a critical factor since Frederick Taylor’s timing of tasks and equating efficiency with profit. Temporal mobility is the reconfiguration of human experience of time through automation and multitasking enabled by IT tools. IT tools such as email and workflow applications enable more tasks to be compressed within a given unit of time, resulting in an increased number of outcomes, thus improving overall efficiency. In short, the use of mobile tools affects not only the spatial dimension, but the temporal dimension as well.

Contextual mobility is the social mobilization of human interactions through IT. Context is, “...not...a defined set of properties...but...instead...an emergent, fluid attribute that is unleashed by the activities imposed on it,” [9: p.75]. Where spatial mobility answers the question “where?” and temporal mobility answers the question “when?”, contextual mobility answers such interaction questions as “in what way?”, “in what circumstance?”, and “towards which actors?” [14: p.4]. User actions are greatly contingent on “local interactions” due to his or her “particular situations” [14, 25]. Perhaps the most important difference between contextual mobility and the other two dimensions is that contextual mobility can do more than simply make current processes more efficient and effective. Contextual mobility is where businesses can find niches for differentiation in the creation of new and previously unimagined services with new revenue streams by transforming the meaning of activities.

The three dimensions of mobility can be a more comprehensive way of understanding the impact of mobility. For example, in a case study involving package distribution truck drivers in Japan in 1999, Kakihara and Sorensen [14] describe the positive organizational impact resulting from the replacement of analog radios with digital mobile Internet phones.

The previous use of the radios was inefficient in the following ways: 1) communication was voice-based and not digitized resulting in incomplete location and status information and 2) the radio systems were installed in the trucks and could not be carried resulting in periodic, unpredicted gaps in two-way communications since synchronization was required between radio users. The adoption of the Internet phones provided spacial, temporal, and contextual mobility managing such contextual constraints as driver availability, truck load capacity, traffic conditions, and package prioritization.

We build on the framework developed by Kakihara and Sorensen by incorporating the notion of constraints on mobility. By taking constraints into consideration, our framework can provide useful guidance with regard to the restrictive forces that need to be overcome in order to fully unleash mobility. This leads to our research question: How can a mobility framework incorporate constraints in order to provide a comprehensive understanding of the emergent impact of the use of mobile tools in the organization?

3. Ubiquitous Connectivity and Mobility

The full impact of contextual mobility will be realized through the implementation of ubiquitous computing. Banavar et al. [1] describe ubiquitous computing as being embedded locally in the environment for performing contextual tasks and where applications are developed and deployed for supporting such tasks. The ubiquitous environment is constantly enhanced with innovative information and capabilities.

An application model for pervasive computing has the following three tenants [1]: 1) the tool as a means of access and not as a repository, 2) the application as the software for performing the task, and 3) the computing environment as the user’s information customized with localized information. As technology becomes invisible yet, embedded everywhere, the services provided through contextual mobility will become an ever increasingly critical part of business organization strategy and revenue.

Lyytinen and Yoo [19] provide a ubiquitous computing framework with the following key drivers: mobility, digital convergence, and mass scale. These
drivers effect *services* which, in turn, become increasingly contextual-based; the supporting *infrastructure* at the same time becomes increasingly invisible for the users. This framework can be used as a tool for IS researchers in mediating social and technical elements in the context of mobile computing as new technologies emerge impacting all levels of the organization.

Within the context of ubiquitous computing, it is increasingly important to develop refined ways of understanding all three dimensions of mobility. Next, we will develop a theoretical framework drawing on a time-geography perspective on mobility. The framework aims at providing a more comprehensive way of researching the impact of IT tools on mobility in all three of its dimensions.

4. Theory Development: A Time-Geography Perspective on Mobility

Our approach in advancing the understanding of mobility is through the lens of time-geography. Through this concept, we see how the use of new IT tools removes constraints experienced in time-geography movements. From this perspective, we develop an IT mobility-constraint framework that integrates the dimensions of mobility with the dimensions of constraints.

4.1. Time-geography

With ever increasing ubiquitous connectivity, mobility is emerging as an important factor that can potentially provide an important strategic advantage to firms. Mobile tools, however, are not yet universally available; and even those firms that accept the same mobile tools will have opportunities to embrace different dimensions of mobility through IT. Organizations, thus, have the potential to differentiate themselves through the effective use of these dimensions mediated by technology. What we need is a way of analyzing the impact of the different dimensions of mobility in organizations.

To address this issue, we take a time-geography perspective on mobility. Time-geography originates with Swedish geographer Torsten Hägerstrand (1916-2004) who views time and space as different but not “inseparable” [22]. An individual’s actions and events have both temporal and spacial dimensions which can be diagrammed in the form of trajectories. The most significant events occur at geographic locations (such as buildings) called “stations” where individuals meet to perform activities as a group or “activity bundle” [10, 22].

Through the lens of time-geography, we can see how the use of new IT tools removes constraints experienced in time-geography movements. An important concept here is the notion of constraint that restricts one’s ability to engage in meaningful activities in time-geography. The anytime and anywhere vision of ubiquitous computing can only be achieved through the removal of these constraints. According to the time-geography perspective [6, 10], there are three types of constraints that need to be continuously managed: capability, coupling, and regulatory.

**Capability constraints** recognize that both humans and tools are unable to continuously interact with one another without interruptions [6, 10]. There are physical, technical, and social factors that contribute to the capability constraints. Humans, for example, need to sleep and eat lunch; systems are prone to speed and connectivity limitations due to physical hardware, software, and networks.

**Coupling constraints** recognize that there are temporal and spatial limitations for humans interfacing with tools [6, 10]. Coupling constraints can be further subdivided between fixed and flexible activities. “Flexible activities” are more easily reduced via re-location or re-scheduling. “Fixed activities”, on the other hand, are more difficult to improve [23]. Even with the support of IT, there are still activities that require time and/or space [16]. For example, desktop computers require a coupling between the tool and a particular location in order to perform a particular task.

**Regulatory constraints** recognize that there are limitations on activities based on rules, norms, and power relationships. It thus primarily deals with the meanings of activities. Examples include official business hours and holidays, as well as areas and/or time periods where the use of mobile IT tools is not permitted [6, 10, 22]. For example, in Japan, voice calls using mobile phones are forbidden on most public transportation systems except for a few specially designated vehicles.

4.2. Overcoming Time-geography Constraints through Mobile IT

The use of mobile IT tools can address the three time-geography constraints. Capability constraints can be reduced through more ubiquitous, seamless, embedded, and invisible IT requiring less human intervention. At the same time, user training and technical savvy help reduce the barriers posed by new IT tools requiring considerable, conscious human manipulation.

Coupling constraints can be reduced through the compression of temporal-spatial requirements through the implementation of faster, more connected, and
more capable IT tools. However, organizations should not count on IT alone for reducing such coupling constraints. The use of new IT tools should be an opportunity to re-evaluate and improve existing processes in producing desirable outcomes.

Finally, regulatory constraint reduction involves the transformation of social meanings of activities, time, or space. New IT tools can have a significant influence on social rules and culture in business.

Capability, coupling, and regulatory constraints affect all three dimensions of mobility through the following four determinants: 1) “location of bases” e.g. where one works and sleeps, 2) “number and length of time intervals” at each base, 3) “travel time ratio” between time spent at a base and time traveling, and 4) “travel speed” directly impacting the time of travel [5, 6, 7, 17]. These four determinants, in turn, limit the mobility of an individual within a geographic space for a given time; this “…spatiotemporal unit is the prism” [6: p.5].

*Action space* is defined as “the (spatial) area in which people undertake activities, or could do so if they wished”, [6: p.3]. The *travel prism* projected on the spatial, geographic area is called the *potential action space* and represents the potential area in which a subject is able to be mobile [2, 6, 17, 27]. Potential human activities are, “…the available opportunities for an individual to conduct and complete certain tasks under specific constraints of space and time…people may be required to travel…to overcome…separations and reach the opportunities,” [26: p.409].

In contrast to potential action space, *perceived action space* is the space in which individuals believe they are able to access, based on imperfect information and imperfect human judgment [3, 6, 11, 18, 24]. The *actual action space* is the area of the intersection between the potential and perceived action spaces and includes the actual activity sites visited by the individual [3, 6, 15, 21, 27].

### 4.3. IT Mobility-constraint Framework

The effective use of mobile tools can reshape action space by changing the three types of mobility constraints. First, the use of new mobile IT tools can yield larger potential and perceived action space. This is done through the reduction of capability constraints [6]. In other words, the use of mobile tools and the implementation of ubiquitous computing environments extend the capabilities of human-tool interactions, thus enabling the types of movements that were previously unavailable. Larger potential action spaces result from enhanced connectivity for greater time-space convergence. Larger perceived action spaces result from the individual obtaining new information through e.g. the Web using IT tools; in short, IT tools expand the perceived horizon of the subject by revealing previously unknown sites e.g. businesses, stores, or restaurants.

Second, the effective use of mobile tools can also affect the mobility constraint by reducing the actual action spaces for individuals by removing unnecessary movements that were created through coupling constraints. Individuals with the help of mobile tools can avoid making unnecessary visits caused by coupling constraints.

Finally, individual actual action space is also influenced by changes in regulatory constraints. This has to do with changes in the meaning of events, activities, time and space. It further is related to normative elements and social sanctions related to the use of time and space.

Time-geography uses a three-dimensional model for illustrating time and space constraints on human activity [10, 26]. Two dimensions are used for the spatial plain and the third dimension is used for the time of the activity (e.g. $t_1$ to $t_2$) as shown in Figure 2.

Yu and Shaw [26] draw upon time-geography extending Hägerstrand’s space-time prism framework for human activities facing spacial-temporal constraints. Potential activity opportunities are different for an individual with remote access to virtual space compared to a subject who does not. Virtual activities can be conducted remotely compared to physical activities; the former still has physical space
dependencies for supporting access channels and infrastructure.

The authors go beyond Hägerstrand’s physical activities to include virtual activities. They accomplish this by intersecting the adjusted space-time prism (adjusted to account for remote access enabled by IT) with wired and wireless access life paths as shown in Figure 2.

Space-time life lines represent individual wired access to virtual activities at a certain point, while space-time life cylinders represent individual access areas via wireless networks. The resulting intersections represent the space-time prism for virtual activities; conventional, non-virtual activities are illustrated by the parts of the prism that do not intersect the IT enabled space-time life paths. One can see, for example, from the intersection in the figure that there is greater virtual activity access through wireless compared to wired technology.

The limitation of the original representation of the adjusted space-time prism intersection is that there is no recognition of the inherent compression of time in performing virtual compared to co-located activities. As we have noted, the reduction of coupling constraints and regulatory constraints can indeed reduce actual action space.

Both IT and non-IT communication tools can be classified by their spatial and temporal dimensions as shown in Table 1. The spatial dimension can be supported by either physical presence which requires the individual to be present at the location of the activity or tele-presence where the activity can be performed remotely through the enablement of IT [12, 26].

The temporal dimension can have either synchronous or asynchronous communication; synchronous communication occurs at the same time and/or place, while asynchronous communication does not. Refer to Table 1 for communication artifact examples. Note that SP stands for “Synchronous Physical” presence, AP stands for “Asynchronous Physical” presence, ST stands for “Synchronous Tele-presence”, and AT stands for “Asynchronous Tele-presence”.

Following the framework presented in Table 1, one can expand the spatial-temporal framework through observation by classifying activities at the individual level; length of time, location, and constraints during periods of no activity can be noted.

For example, employee “A”: 09:00-11:00AM “AT”, 11:00-12:00PM “ST”, 12:00-1:00PM “Capability Constraint: Lunch”, 1:00-1:15PM “AP”, 1:15-2:00PM “AT”, etc. This analysis can also identify opportunities for improving the use of mobile IT tools with respect to the temporal and spatial dimensions.

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Table 1. Communication tool classification by temporal and spatial constraints [20, 26]

<table>
<thead>
<tr>
<th>Physical presence</th>
<th>Synchronous</th>
<th>Asynchronous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face to face (F2F)</td>
<td>SP</td>
<td>AP</td>
</tr>
<tr>
<td>Post-it® notes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional hospital charts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telephone</td>
<td>ST</td>
<td>AT</td>
</tr>
<tr>
<td>Online chat rooms</td>
<td></td>
<td>E-mail</td>
</tr>
<tr>
<td>Teleconference</td>
<td></td>
<td>Webpage</td>
</tr>
</tbody>
</table>

Ultimately, measures using the spatial-temporal table can result in the following benefits: 1) opportunities for analyzing and improving tool-utilization, 2) reasons for utilizing multiple IT and non-IT enabled tools, and 3) recognition that despite digital convergence, a black box such as a particular device is most likely not a permanent solution [13]. Configuration should be such that information is able
to flow across the increasingly connected, heterogeneous environment.

One particular area that needs further elaboration is context so that it can be better integrated in a 2D “contextual area” or “contextual plain” with the time-geography framework of Yu and Shaw [26]. As Dourish [8] states, “…the role of context in interaction extends beyond simply the sort of spatial and temporal connects that lies at the heart of the UbiComp vision…beyond this we also need to account for social, cultural, organizational, and interactional context, which are equally telling for the ways in which action will emerge,” (p. 234).

Taken together, we now propose an IT mobility-constraint framework (Table 2) by combining mobility’s three dimensions of time, spatial, and contextual with the three constraints of capability, coupling, and regulatory in this 3 by 3 table. We present this framework with examples in the case study which follows. The IT mobility-constraint framework provides a view for not only current time and spatial mobility constraints, but also a view of future opportunities particularly through contextual mobility.

5. An Illustration of the IT Mobility-constraint Framework in the Case of Center City Philadelphia

The Center City District (CCD) is a downtown Philadelphia private-sector organization that works together for the overall goal of maintaining the public spaces of the downtown area so that it continues to be a desirable place for residents, tourists, and businesses. The district is comprised of 120 city blocks and 4,500 properties as outlined in Figure 3.

The CCD organization employs 42 Customer Service Representatives (CSRs) who patrol the CCD area serving as goodwill ambassadors, augmenting the police and public safety services, and reporting material discrepancies in the public spaces for resolution. CSRs carry a radio for two-way voice communications with the CCD dispatcher at headquarters. PDAs are used by some of the CSRs for digitally recording observed discrepancies for bi-monthly public space survey reports. Three teams of two persons perform these survey patrol duties with one of the two CSRs using a PDA for data entry.

The remainder of the CSRs patrols in solo without a PDA recording discrepancies using a pen and paper form. When the CSRs started recording and tracking discrepancy data in the early 90’s, all entries were made by all CSRs by paper form. All CSRs carry a notebook for manually logging “hospitality ambassador events”. Hospitality ambassador or “HA” events include such services as providing directions, answering questions, and administering first aid.

Discrepancies recorded include items owned by agencies such as the phone company, responsible for cleaning telephone booth graffiti, and news distributors, responsible for repairing smashed newspaper machines. The CCD headquarters, in turn, uses this data for generating discrepancy or “survey” reports for the responsible agencies for resolution.

Originally all of the data for these reports was manually entered into a centralized database. The means by which the completed reports have been sent to the responsible agencies has, for the most part, progressed over time with advances in technology from phone to fax to currently e-mail attachment. Some agencies, however, still lack e-mail connectivity and continue to receive the reports from the CCD headquarters by fax.
In July 2004, a portion of the CSR foot patrols began utilizing the hand-held Computerized Neighborhood Environment Tracking Program (ComNET) software on Casio PDAs. This PDA was replaced in January of 2006 with the Dell Axim PDA which came with enhanced reporting software for customizations. The Dell Axim continues to be used by three teams of two CSRs every other week with the remainder of the CSRs continuing to use paper forms in reporting observed discrepancies.

While the PDAs tend to have slow response and occasionally lock up, this technology enables the electronic reporting, tracking, and resolving of observed discrepancies for more than 1,300 blocks involving 23 responsible agencies. 83 various streetscape elements are tracked using what have evolved to be over 500 unique condition codes. The CSRs that use the PDAs receive six hours classroom training followed by two hours “hands on” training in the field. The complexity of the technology is still a barrier for greater adoption for the remainder of the CSR team.

In our findings, discrepancies recorded on PDAs range from 550 to 1,000 per month with an average of 687. Typical discrepancies reported include broken sidewalks, broken or missing parking signs, pot holes, graffiti, litter, defective streetlights, broken fire hydrants, dead trees, backed-up sewers, significant bird droppings on buildings, noise pollution, air pollution, overflowing dumpsters, damaged transit shelters, and vandalized pay phones. Blocks which do not have any observed issues are classified as “clean blocks.”

There are thirteen “beats” or routes labeled “A” to “M”. While there is an electronic map available through the PDA software, the GPS capability is not used due to signal interference from the height of the buildings downtown.

The PDA software is designed so that the user enters location, streetscape element (the item having the problem), and condition code (the actual problem experienced by the item). The application has the user go through the following sequence whenever data is entered for a particular location: 1) street 2) curb 3) sidewalk 4) building front and 5) building top. The CSR then manually enters the address of the location and any notes for additional precision, for example, “NW corner” to note the “northwest” corner.

This PDA data is downloaded in batches at the end of each shift at the CCD headquarters for reports that automatically generate maps showing the discrepancy locations. The downloading enabled by the PDA system is more efficient than manually entering data from the paper forms. CCD management checks the reports and eliminates any duplicate data entries.

The City of Philadelphia’s Managing Director’s Office at the CCD headquarters serves as a point of coordination for many of the responsible agencies receiving the reports. Reports are produced bi-weekly by the CCD for dissemination to the responsible agencies; the agencies, in turn, have a two-month lead time to resolve their discrepancies.

In Table 3, we apply the IT mobility-constraint framework to the current and potential future impact of mobility for Philadelphia. The temporal and spatial rows provide examples of how mobility is currently implemented and the contextual row shows examples of how contextual mobility can be implemented for the future.

The examples under the capability constraint column show how the current technology and users both constrain and enable temporal and spatial mobility. The synchronous hand-held radios used by the CSRs lack asynchronous capability and, thus, limit the activities that can be performed within a particular timeframe. From the user’s perspective, the current PDA technology takes time to learn and time to enter the data.

Similarly, spatial mobility is constrained by the current version of PDA software which does not allow any flexibility in the CSR routing sequence. Thus, with respect to both time and space, a more user-friendly, flexible tool would help reduce current capability constraints by expanding the action space, and, thereby, improving efficiency.

Contextual mobility possibilities include creating new forms of social interactions in order to overcome inherent capabilities restrictions. For example, by using mobile IT tools, the CCD can overcome the restrictions that come from the data collection done by a small number of CSRs at particular times of the day. This new form of data collection can provide new sources of information for the CSRs who share the information with the tourists and citizens that they meet while walking the streets. Here, we see the expansion of both the perceived and potential action space through the use of mobile IT tools.
The coupling constraints for the case study show de-coupling and re-coupling flexible activity opportunities for mobility in the areas of reporting and CSR tracking. This often leads to the reduction of actual action space. Enhanced IT tools can improve the efficiency of CSRs by de-coupling activities and space through the use of technology. For example, through the automatic tracking of CSRs as well as real-time uploads of reporting data, the CSRs are able to complete their tasks without having to physically return to headquarters.

Another coupling constraint example is the manual entering of data from the paper forms to the centralized database located at the CCD headquarters for Table 3. IT mobility-constraint framework with examples

<table>
<thead>
<tr>
<th>Capability Constraints</th>
<th>Coupling Constraints</th>
<th>Regulatory Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporal (current)</strong></td>
<td>1. Discrepancies recorded by paper form need to be manually entered into digital format for bi-weekly reporting.</td>
<td>1. Three shifts of customer service representatives provide coverage from 07:00 AM to 11:00 PM, seven days a week.</td>
</tr>
<tr>
<td>2. Before going out on patrol, the CSRs attend morning briefings with the CCD police department in order to be updated on the latest local law and security issues.</td>
<td>2. Discrepancy reports are sent to the 23 agencies on a bi-weekly basis.</td>
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<tr>
<td>3. When a PDA is used, the CSRs patrol in pairs since entering data by PDA can be time-consuming. When pen and paper form is used, the CSRs are able to patrol solo.</td>
<td>3. The responsible agencies have two months to resolve their reported discrepancies.</td>
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<tr>
<td>4. Citizens and businesses in the CCD report discrepancies and ask for status updates by phone.</td>
<td>4. Some agencies do not resolve discrepancies as quickly as others; most of the 23 agencies do not fall under the control of the CCD organization.</td>
<td></td>
</tr>
<tr>
<td><strong>Spatial (current)</strong></td>
<td>1. Predetermined routes are “hard-coded” in the PDA software.</td>
<td>1. Patrols are limited to a specified area downtown.</td>
</tr>
<tr>
<td>2. The downtown skyscrapers block satellite signal reception preventing the use of the PDA GPS mapping capability.</td>
<td>2. Budgeting limits the number and frequency of CSR patrols as well as the purchasing of additional PDAs for the entire CSR team.</td>
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</tr>
<tr>
<td><strong>Contextual (future)</strong></td>
<td>1. Discrepancy reporting requires human observation in the physical space.</td>
<td>3. The CCD organization is responsible for the center city area; most of the 23 agencies are responsible for the entire city.</td>
</tr>
<tr>
<td>Remote detection of citizen movements integrated with weather for crowd control and emergency response readiness (e.g. “the line for the Liberty Bell is extending outside the pavilion, temperature is 97 degrees, and humidity is 99 %”).</td>
<td>2. Recorded data in the PDAs needs to be uploaded in batches from the PDAs into a central database located at headquarters after each patrol for the bi-weekly reports to the agencies.</td>
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</tr>
<tr>
<td>Empower, receive, and broadcast information from citizens, tourists, and businesses regarding cultural, historical, and tourist events currently in progress in the area (e.g. “my kids are really enjoying the stories that ‘Ben Franklin’ is telling in front of Betsy Ross’s house”).</td>
<td>3. CSR location is tracked by radio communication or visually by automobile.</td>
<td></td>
</tr>
<tr>
<td>Enable citizens in the surrounding neighborhoods to use hand-held devices to report, track, and exchange information regarding public space discrepancies and resolutions as well as community-interest events in their own localities.</td>
<td><strong>Regulatory Constraints</strong></td>
<td></td>
</tr>
</tbody>
</table>
generating reports. PDA upload capability reduces the action space required for this activity. Real-time uploads would further reduce the action space required.

The human reporting of discrepancies, however, is a fixed activity coupling constraint. This activity can become flexible when the technology is feasible for implementing the remote sensing of discrepancies such as graffiti on building walls, broken sidewalks, and overflowing or overturned trash bins.

The de-coupling of activities, actors, and places allows one to envision these relationships with a diverse set of visitors. With the creative re-coupling of these activities, actors, and places through the novel applications of IT, the CCD can envision new forms of social interactions taking place in different parts of the city. Thus, contextual mobility could eliminate the need for being at places and spending time in order to receive feedback of events from tourists and citizens.

Finally, the examples for regulatory constraints show the current time and space constraints from such limits as working hours and designated patrol spaces. Additional regulatory constraints include the lack of jurisdiction of the CCD organization over all 23 agencies receiving the discrepancy reports and the fact that the agencies have an expected lead time of two months for resolving reported issues. The CCD organization is responsible for the center city area, while most of the agencies are responsible for the entire city.

Budgeting also limits mobility in the CCD organization in, for example, the number of CSRs performing patrols, the number of CSRs trained and issued PDAs, and the sophistication of the mobile technology purchased. Newer, more cost-effective technology could reduce these regulatory constraints by shifting the balance of power from the individual agencies to the CCD organization, thus, helping improve response time and the follow-through of reported discrepancies.

For example, enabling the public to digitally view discrepancies reported to the various agencies on the Internet would result in a greater sense of urgency by the agencies as quickly respond due to the new transparency. No agency would want to be known by the public as having the worst customer response time or resolution rate. Real-time discrepancy reporting directly to the agencies would reduce the current reporting lags.

Similarly, enabling customers to report and track their own discrepancies through an asynchronous Website instead of just by synchronous phone calls would further help balance the power from the various agencies towards the CCD organization and the customers, businesses, and tourists it serves. Mobile IT tools could thus transform the current regulatory environment by making all city agencies perform their duties with a greater sense of urgency.

The regulatory constraints column also shows the possibilities of expanded time, space, and context coverage beyond the downtown area and beyond the reporting of discrepancies. The regulatory constraints column is where reactive ways of doing business can be converted to proactive ways. Overcoming regulatory constraints posed by outdated laws, norms, organizational cultures, and unbalanced power relationships is possible through IT enabled mobility resulting in the transformation of action space.

6. Concluding Remarks

Organizations have begun implementing various forms of mobile technologies. However, the full potential of mobile technologies in everyday work practice is yet to be fully achieved. One of the challenges is not having a theoretical framework that can be used to envision, analyze, and evaluate the potential and enacted impact of mobile technologies in organizations.

In order to address the gap, we propose the IT mobility-constraint framework, drawing on a time-geography perspective. The framework allows organizations to envision opportunities to improve organizational performance through the deployment of mobile tools. This can be done by constructing potential and perceived action space. In particular, the framework can show how certain areas of action space can be expanded, reduced, or transformed by addressing capability, coupling, and regulatory constraints.

The framework further reveals opportunities for organizational improvement in the use of mobile IT tools across the multiple dimensions of mobility. In addition, the expanded framework can provide greater understanding of contextual mobility evolving through the growing ubiquity of computing. Organizations may use this concept to differentiate themselves from the competition through the creation of new, unimagined services.

The IT mobility-constraint framework can also be used to evaluate the impact of the implementation of mobile IT tools in organizations. This can be done by comparing the actual action space before and after the implementation of the tools. Such comparison provides a more concrete understanding of the impact of mobile tools, whose impact is often elusive.

In short, the impact of emergent mobile IT tools leads to positive activity outcomes by minimizing capability, coupling, and regulatory constraints. This is
accomplished through the enablement of efficiency, effectiveness, and transformations.

This paper shows the development and use of the IT mobility-constraint framework integrating the dimensions of mobility with those of constraints. This framework, in turn, provides a lens for researching the emergent impact of the use of mobile tools overcoming constraints in the organization.

Further research is needed for defining systematic ways of measuring mobility’s third dimension, contextual mobility, with respect to its constraints. New, unimagined, mobile-enabled, digitized services can be provided through dynamic virtual teams in flat, fluid organizations. As contextual mobility expands, emergent mobile tool mediation will have an increasingly positive effect on organizational outcomes.

References


