User Appropriation of Mobile Technologies: Motives, Conditions and Design Properties[1]

Gamel O. Wiredu

Information Systems and Innovation Group, Department of Management, The London School of Economics and Political Science, Houghton Street, London WC2A 2AE, UK

Abstract

The mobility of activities entails intrinsic parameters such as the mobility of tasks and technologies, as well as changing conditions underlying mobile computing. The interactions between these parameters bear directly on the appropriation of mobile technologies deployed in these activities. In this paper, I analyze the appropriation of mobile technologies as a function of motives, conditions of use, and technology design properties. The analysis explains the flexibility of mobile computing as a direct function of the appropriation process. The paper contributes to understanding mobile technology use and improving user acceptance by extending existing conceptualizations of technology use. Technology personalization and use in non-organizational contexts are the essentials of the extension, suggesting that mobile computing is a function of use for serving both organizationally-sanctioned and personal motives. Implications for researching mobile technology use and for designing mobile technologies are drawn.

Keywords: appropriation, motives, conditions, activity, mobile technology, mobile computing.

---

[1] This paper has been accepted for publication in the *Information and Organization* journal. Changes resulting from the publishing process such as minor corrections and other quality control mechanisms may not be reflected here.

1 Introduction

Portable information and communication technologies (ICTs) – also known as mobile technologies – have invaded our lives, and they are increasingly being deployed in activities which require human mobility. Yet, in spite of some conceptualization attempts on mobile technology use (e.g. Sørensen and Pica 2005, Scheepers et al. 2006, Weilenmann 2001, Sarker and Wells 2003, Wiberg and Ljungberg 2001, Waycott 2005, Cousins and Robey 2005), the interrelations between mobile activities and mobile computing in terms of individual appropriation of portable computers have been almost taken for granted within Information Systems (IS) research. Mobility of activities and mobile computing present significant challenges for IS research (Lyytinen and Yoo 2002, Hamill and Lasen 2005) which, in the past, has largely concerned itself with desktop ICTs such as mainframe and desktop computers. The mobility of activities entails intrinsic parameters such as the mobility of tasks and technologies, the dynamic motives held by technology users, and the changing conditions underlying mobile computing. However, how mobile individuals compute with portable technologies in mobile activities, and how and why they appropriate these artifacts as they derive mobile computing services from them have seen little exploration and clarification in the IS literature.

Within the realm of static and bulky technology use, Orlikowski (2000, p.423) suggests that it is important for both researchers and practitioners to "better understand how and why people are likely to use their technologies and with what (intended and unintended) consequences in different conditions." Davis and his colleagues (1989, p.982) also talk about the need for "a better understanding of why people resist using computers in order to derive practical methods for evaluating systems, predicting how users will respond to them,

and improving user acceptance by altering the nature of systems and the processes by which they are implemented." In this day of the proliferation of portable computers (which constitutes a different technological context), there is a similar need for understanding, predicting and improving portable technology user acceptance in IS research and practice. This paper takes up the challenge to conceptualize portable technology use through an analysis of the appropriation of personal digital assistants (PDAs) in a mobile work-integrated learning project.

Existing perspectives on technology use include perceived usefulness and perceived ease of use (Davis 1989, Davis et al. 1989, Adams et al. 1992), usability (Goodwin 1987), task-technology fit (Goodhue 1995, Goodhue and Thompson 1995), reinvention of innovations (Rice and Rogers 1980, Rogers 1995, Boudreau and Robey 2006), and structuration (Orlikowski 1992, 2000, DeSanctis and Poole 1994). Common to these perspectives is a very notable concept, the "social construction of technology," which suggests that a group's shared judgment of the functional essence of any technology is determined by the context in which it is used and the sense the group makes of it within that context (see, for example, MacKenzie and Wajcman 1985, Bijker et al. 1987, Bijker 2001). This concept – seemingly borne of Berger and Luckmann's (1967) treatise in the sociology of knowledge – illuminates the difference between the intended and functional aspects of the essence of both physical and psychological tools. Physical tools such as ICTs and psychological tools like theories and languages (Vygotsky 1978, Engeström 1987) both have intentional essences that differ largely from their functional essences (Searle 1995, p.14). This analytical contrast has proven very important for understanding the mutual shaping between organizations or society and the shared judgment of functional essence in

technology use; however, it does not seem to be completely applicable to our understanding of portable technology use. Three reasons account collectively for this.

First, variable conditions underlying portable technology use: Expositions of the collective evolution of functional essence normally concern static technologies that are deployed and used in collocated and fairly static activities in organizations. In such contexts, the functional essence of technology is linked intrinsically with static locations and excludes contexts in which users act outside of such locations. To wit, existing conceptualizations of technology use are, essentially, bound to static technologies being used in collocated activities by fairly static users. However, the functional essence in terms of portable technology use in mobile activities by mobile users will present different and unique challenges (see Sørensen and Pica 2005, Lyytinen and Yoo 2002, Sarker and Wells 2003, Weilenmann 2001, Wiberg and Ljungberg 2001). Thus, while task-and location-related conditions are fairly constant for computing in collocated activities, these conditions are highly variable for mobile computing in mobile activities.

Second, portable technology personalization: Portable technologies are largely personal technologies, personal in the sense that their portability enables personalization (appropriation to serve personal motives), 'wearing' and easy transportation by individual users (Geisler 2003). Portable technologies can be carried by an individual anytime anywhere (although they cannot be used every time everywhere); and this portrays a scenario that contrasts with static and oftentimes bulky technologies that can only be used in particular locations at particular times. Thus, when they are deployed to serve sanctioned mobile activities, such deployment entails their use to serve users' personal motives. A personal motive may not necessarily conform to the motive behind his or her sanctioned

activity, but it is certainly directly related to the personal needs of the individual user and can be as strong as the motive behind the sanctioned mobile activity. Thus, from the viewpoint of the user, deriving personal support from the personal computer may be as important as using it to support the sanctioned mobile activity.

Third, personal-level evolution of functional essence of portable technology: The functional essence of technology in terms of social construction has been conceptualized on the collective or organizational level of use. Therefore, such conceptualizations portend the collective evolution of the functional essence. In mobile activities, however, the evolution of functional essence occurs at the individual level where mobile users of portable technologies largely operate alone in distributed locations. The judgment of functional essence at the individual level is profoundly different from the collective level because the conceptualization of technology use is derived from how functional it is to both the individual and the collection as he or she uses it in a mobile activity.

The evolution of the functional essence of a portable technology in a mobile activity will, therefore, result from the individual user's appropriation in various conditions. Yet, what we seem to lack is a conceptualization of *how* and *why* portable or mobile technologies are appropriated as they are used in mobile activities and the implications for improving user acceptance of mobile technologies. This paper takes up this conceptualization challenge. Based on the philosophical assumptions of Activity Theory (AT) (Vygotsky 1978, Leont'ev 1978, Engeström 1987), I conceptualize mobile computing in terms of appropriation of portable technology, and explain why users' motives, technology use conditions, and technology design properties are significant determinants of the flexibility of mobile computing. To some extent, some existing perspectives on

technology use have tackled aspects of this challenge, and they have been very useful in improving our understanding of ongoing changes in technology and use (e.g. Sorensen and Pica, 2005, Orlikowski, 2000; Davis et al., 1989).

However, while these perspectives talk about the role of motives and conditions in shaping technology judgments, they do not explain technology use in terms of the differences between personal and oganizational motives, nor do they explain the implications of such differences on mobile technology use. Besides, their explanations of different conditions largely border on technological and organizational dimensions, rendering them insufficient for analyzing portable technology use conditions that lie outside the organizational space. AT, however, offers insights on human activities, the motives that drive them, their underlying conditions, and the implications for appropriation of tools. Such insights are helpful for teasing out the differences between personal and organizational motives, and, hence, the implications for portable technology use. The theory is also applicable for analyzing technology use in non-organizational (personal) conditions. Thus, an activity perspective has greater potential to explain better how and why people use portable technologies in both personal and organizational contexts.

2 Motives and Conditions of Activity

According to the philosophical assumptions of Activity Theory, in any conscious human activity, there is a *subject* who pursues an *object* with a *motive* to transform the object into an outcome. The object can be tangible (e.g. a piece of leather) or intangible (e.g. some skill), human or non-human and static or dynamic. The subject's pursuit of the object is mediated by a *tool*; that is, the subject acts on the object with a tool to transform it

(the object) into an outcome. The transformation defines the *motive* of an activity; and the pursuit embodies actions. An activity "answers a definite need of the subject, [and] is directed toward an object of this need…" (Leont'ev 1978, p.62). The motive is aroused when the person has identified an object which he or she perceives will satisfy his or her need. The motive is a result of stimulation in the consciousness of the subject by biologically- and sociologically-satisfying external objects; and an object gives an activity a determined direction.

In some activities, the subject collaborates with other people who, together, form a *community*; therefore, the activity is intrinsically complicated by the community of collaborators, the tacit and explicit rules which regulate their actions, and the implicit and explicit division of labour which manifest. Theoretically, the community essence of an activity suggests that individuals in the community may be transforming different objects, and hence the motives driving their individual activities will be different from or even contradict the motive of the community's collective activity. This means that, even when the transformation of the "collective" object appears to represent a single collective activity (as in an organizational activity), the outcome of the transformation is achieved through that activity's interactions with others that are championed by individuals or groups in the community (Engeström 1987). An organization is an epitome of a collective activity whose employees work towards achieving the organizational motive, and at the same time, towards achieving their individual personal motives. The collective activity is, essentially, socio-cultural because the legitimacy or acceptability of its constituent actions and outcome is dependent on the socio-cultural context defined collectively by the community, and not by the individual. The motives and actions of the collective activity are, therefore, more

objective. Contrarily, an individual's activity is personal and subjective because the legitimacy of his or her motives is self-determined.

The use of tools or instruments in activities engenders appropriation of those tools. "An adequate relation between man and tool is therefore primarily expressed in his appropriating (practically or theoretically – only in their significance) the operations fixed in it, by developing his own human abilities" (Leont'ev 1981, p.296). Appropriating is an integral process of human development, and development is achieved through activities. This integral nature of appropriation shows in Marx's (1976, p.87) explanation: "The appropriation of the totality of instruments of production is, for this reason, the development of the totality of capacities in the individuals themselves." This means that appropriating a tool is an *active* process; that occurs *during* use of the tool to support a person' activities and, hence, development. And the challenge for this paper lies in showing why (the motives of an activity) and how (the conditions therein) appropriation of portable technology occurs in mobile activities.

The general macrostructure of an activity incorporates both internal (mental) and external (physical) activities of the subject; it is constituted by a series of conscious and goal-oriented actions which are also constituted by subconscious operations (see Figure 1).

Insert Figure 1 about here

A series of actions together constitute an activity, and they are conducted through a planning-orientation-execution phase. This implies that actions are performed consciously

and are directed at the achievement of immediate or intermediate goals. Generally, actions result in goals which, together, constitute the motive that stimulates an activity.

Compared with actions that are consciously performed, operations are subconsciously performed. An operation is determined by the goal which is given in certain objective *conditions*. Operations degenerate into actions when the subject encounters adverse conditions in an activity. On the other hand, when actions are mastered, favorable conditions permitting, they become operations. For example, the process of learning to drive a manual car in dry weather proceeds from changing conscious actions such as speed, steering and pedals control into subconscious operations. But then those operations are likely to change back into conscious actions when it begins to snow and the road gets slippery because, all of a sudden, speed, steering and pedals controls will begin to re-demand the consciousness of the driver.

The variable conditions in a mobile activity which spawn the back-and-forth mutations between actions and operations have direct implications for mobile computing and, hence, of user acceptance of portable technology. The portable computer being a tool and being used to transform an object into an outcome, mobile computing will constitute a subconscious operation to the subject (user) when conditions are favorable. In adverse conditions, however, mobile computing will constitute a conscious action or, in the worst scenario, it will constitute an entire activity. When computing becomes an action or activity, the technology will represent an object instead of a tool and mobile computing will displace the erstwhile actions or activity which the technology was deployed to support.

The upshot is that the functional essence of a portable technology will depend on the combination of the motive behind the activity it is supporting, the conditions underlying its

use, and its design properties. These three factors are separated only for analytical purposes: in reality, they are intertwined intrinsically. An essential aspect of mobile computing is the mode of mobility of the user which can be micro as in bodily movements, local as in wandering from one point to another within a small area (e.g. big building), or remote as in traveling (using transport technology) from one location to another (see Luff and Heath 1998, Lyytinen and Yoo 2002, Kristoffersen and Ljungberg 2000). Human mobility transcends objective or organizational contexts to include personal contexts; and portable technology use by mobile humans will likewise follow such transcendence. It follows from this that the user's judgment of portable technology will be premised on both organizational and personal contexts; that is, on the technology's serving of both organizational and personal motives under various conditions.

3 Research Setting

To understand the dynamics of portable technology use in mobile activities, I undertook a 12-month empirical study of mobile computing in a work-integrated learning (WIL) project in the British National Health Service (NHS) from April 2003. It was a pilot project in which twelve health professionals were being trained for a new professional role in surgical care. The new role was being created to fill an impending man-hour or skills shortage which would be left by junior doctors as their weekly hours were being cut from an average of 72 to 56 by the European Union Working Time Directive (EUWTD).

The project was characterized by mobility – of the twelve trainees/learners, of the learning activity, of the PDA use, and of information. It entailed *micro*-mobility in the sense of the learners' bodily movements in performing clinical actions and in their PDA

use; it entailed *local* mobility within each learner's hospital; and it entailed *remote* mobility to and from the training coordination centre in London (Luff and Heath 1998). PDAs were officially adopted and deployed to provide computational support for this activity. Particularly, the highly critical issues of monitoring and remote control of the learners' activities in their individual hospitals and the development of learning portfolios were the targets of the computing support.

Remote monitoring and control of clinical actions, and the development of portfolios of evidence of those actions undertaken were requirements whose fulfillments were aimed at satisfying two parties. First, the sponsors of the project, the European Union, had to be fed with reports and statistics of proceedings of the training project. These reports would convey the details of the actions that were actually undertaken by the learners in their hospitals with the aim of underlining the credibility of the whole training exercise and hence of the new professional role. Second, the wider community of existing medical professionals had to be satisfied that this new professional role was credible. Since professions in the medical field are characterized by inertia and conservatism, the success of this new profession depended on their acceptance and trust. Thus, documentation of clinical actions and the resultant portfolios were meant to provide evidence of the depth and breadth of learning actions undertaken by the learners for accreditation purposes. Such evidence was essential for professional validation and accreditation in the NHS.

Each learner was provided with a Compaq iPAQ H3970 model PDA which was running a Pocket PC 2002 operating system. Each was also given a foldable keyboard to facilitate their input of written reflections-on-action (Schön 1983) onto the PDA. This PDA model has an inbuilt appointment calendar, address book and limited or 'pocket' versions

of Microsoft® Word® and Excel® and Outlook®. These were deployed to be used by the learners as tools for capturing information on the spot, for reading information, for recording clinical and learning activities, for writing reflections right after every learning action, for sharing information, and for transfer of relevant data to the monitoring centre in London. They were supposed to be used to process notes and other information while roaming from one ward to another and in other locations of their hospitals as their training demanded. Their learning process and outcome demanded that it was crucial to record actions *when* they were done, not at the end of the day, and the PDAs were deployed to fulfill immediate and easy capture and processing of information.

An actions logging database that held recorded details of patient encounters on the wards was to be developed by each trainee. Clinical activities were to be selected from a predefined 'pick list' through tapping a stylus directly on the PDA screen. Additional data included details such as the initials of any supervisor and whether a performed action was an elective or emergency. The patient's age and gender were recorded but in accordance with data protection legislation their names were not.

There was also a learning Reflective Journal which consisted of a set of templates with headings such as "thoughts and feelings?" and "what worked and what didn't?" These were intentionally open-ended questions which would allow the learners to frame the answers as they wished. Answers to these questions were to be typed as reflections-on-actions at the end of each learning day using the foldable keyboard.

It was envisaged that the PDAs would provide learning support to the learners through the accumulation of relevant learning resources – medical literature, drug calculators and formulary – which could be available to the learners anywhere during their learning

manoeuvres. Compared with the scenario in which learners have to make visits to libraries to gain access to learning resources, or the one in which the learner burdens himself or herself with the task of carrying paper versions of those resources, the PDA would save the trainee some library visits as well as the effort to carry many books while roaming. It was envisioned that when a PDA is inscribed with theoretical medical information and used in practical learning environments, the user/learner could intermittently refer to this information to shape his- or her meaning-making from the practical clinical actions.

4 Research Methodology

With theory development in mind (Weick 1989, Eisenhardt 1989, Tsoukas 1989), I adopted induction in my exploration and analysis (Schutz 1954). While induction requires researchers to open themselves up to all possible emerging issues in their studies, it also calls for delimiting and focusing of domain of inquiry. Thus, my study focused on patterns of human mobility, design properties of the portable technology, individual and organizational motives, and conditions underlying mobile computing within the activity. My data collection and analysis sought the dynamic relationships between these parameters, and how and why the learners appropriated the PDAs according to these dynamics.

4.1 Research Design

I conducted the study as a clinical action researcher (Schein 1987). More specifically, I played the role of a participatory action researcher through active collaboration with the trainees and the authorities of the project. In addition, I participated as a direct observer in many of the London-based modules and led the training of the trainees on how to use the

PDAs. Furthermore, I assumed the role of a 24-hour 'helpdesk' support to them – they could call me on the phone anytime for help when they encountered any problems with the use of the PDAs. My role, therefore, oriented towards a facilitator, an active participant, and a "clinician" (Schein 1987). I have to emphasize that I was strictly an action researcher doing clinical field work not a consultant: I accepted the invitation to participate in the project not to gain monetary rewards from the project but to use the opportunity as a means to obtain as much in-depth information as possible. In terms of all of Baskerville's (1999) five key parameters for distinguishing between an action researcher and a consultant – motivation, commitment, approach, foundation for recommendations, and essence of organizational understanding – I was an action researcher. And in terms of Baskerville and Wood-Harper's (1998) categories of action research, I was a clinical action researcher in the sense of Schein (1987).

My collaboration with the practitioners in helping to solve their problems was immensely beneficial on several counts. The most significant was the induction of trust and confidence they had in me from the beginning. Offering myself as a facilitator for the adoption of technology and implementation of technology decisions in the project was welcoming to the project leader in cost-saving terms; it was also welcoming to me on the grounds of my abilities to resolve most of the emerging problems. In so doing, I did not win just the trust and confidence of the project leader; most crucially, I also won the trust and confidence of the trainees. This achievement was very significant because it eased my access to information and facilitated the process of data collection at all levels of the project set-up from the outset to its conclusion.

4.2 Data Collection Methods

I held several meetings, conversations and interviews with the project manager and trainees from the beginning of the project to its end. Although, these meetings were far fewer in number compared, for example, with interviews, they were reliable and rich sources of information on motives, conditions underlying clinical actions, learning rules, community and division of labor.

Formal yet open-ended interviews were also conducted face-to-face during my visits to the trainees' hospitals; and on telephone. It has to be said, in addition, that the face-to-face formal interviews were largely interspersed with conversations as part of my problem-solving role in the project. In a typical scenario, information about the PDA's use would be immediately forthcoming from a trainee at the time I make a request on telephone to pay him or her a visit in the hospital. Then as I arrived at the hospital later on, the very first words of exchange would be either banters or serious remarks about his or her experiences with the use of the PDA. This conversation would continue along the corridors and staircases until we finally settled down in the canteen or in his or her office in the hospital before a formal interview commenced. Other instances of informal conversations occurred when they had returned to London for their modules: beside the tea-table, in the classroom before a session, in the canteen, and during the official three-hour "PDA session" of every module.

An official "PDA session" was designed by the project leader to allow the application designers and I to interact with the trainees and solicit their problems and concerns about the PDAs use in their learning activities. These sessions always presented me with opportunities to ask collective questions and to organize workshops with them. They also

presented settings in which their personal experiences were shared among themselves, revealing critical information that could not be discussed in a formal interview.

There was also another three-hour session of every module named as “How things went.” This session was always the first of every module; it was designed to solicit feedback and experiences from the trainees in relation to their learning experiences of the previous six weeks spent in their individual hospitals. “How things went” were always very emotional and presented the trainees with the official opportunity to pour out their feelings. Although it was the project leader himself who moderated the “How things went” sessions, I was present as an observer in all of them and took notes of the proceedings.

Over the period, I also exchanged several e-mails with all members of the project. However, most of these e-mails consisted of exchanges with the trainees on the experiences with technology use. E-mailing was an option I provided them to reach me if I was not available to receive a phone call. It was very helpful in the data collection because it represented a medium through which the trainees were more expressive of their feelings. Besides, the a-contextual nature of e-mail text, its associated asynchronous interaction, and its unobtrusive nature ensured that interaction was convenient for the trainee and I at any time. Some of their e-mails were additions and confirmations of problems that had been discussed beforehand, serving as double-checks on the data received.

In all several tens of hours were spent – formally and informally, directly and indirectly – in collecting verbal, textual and pictorial data from the project authorities and trainees.

4.3 Data Analysis

Data analysis was conducted alongside and after my data collection. My interventions as a facilitator of the learners’ mobile computing in the project were occasions for gaining

first hand information on their experiences – both computing and non-computing related. In the beginning, my analysis occurred as part of or in-between these occasions as it was necessary for me to apply some theoretical ideas about mobility, technology-mediated learning and systems development to understand the information they provided me and suggest solutions for subsequent technology designs. While my aim was to see the learners' technology use experiences improve, I was, at the same time, developing my understanding iteratively through their reporting.

As the earlier design problems were being overcome, it became clear to me that the main challenge facing technology use was not the designed applications but rather how difficult it was to use technology in the clinical setting. Then after receiving reports that use in non-clinical contexts was successful, I drew upon the conditional and motivational principles of Activity Theory to understand how and why the clinical setting did not permit mobile computing while the non-clinical setting did. Part of this drawing was done during my data collection; and the derived understanding was evaluated also during my data collection. After the data collection period, I continued with full scale analysis with the aim of inducing some general principles on the challenges of mobile technology use in mobile activities.

5 Results

5.1 Success-and-Failure Perceptions

As far as the training project was concerned, the PDA and all the custom applications that were designed to provide mobile computing support for the learners were deemed as failures after the implementation period. There were three custom applications that were used by the trainees for information management; but, even though each next one was

better than the previous, they all could not be used in the clinical setting. The technology could not be used in the clinical setting because of both design and environmental conditional problems. The systemic design properties of the PDA itself was a major limitation – low level processors, slower to manipulate, smaller memories and limited input mechanisms are typical examples. This in turn affected the custom applications that were designed into them, but subsequent prototypes overcame these essential design limitations. Thus, in the end, it was the highly mobile nature of their clinical duties around the hospital wards ensured that contemporaneous mobile computing was not feasible or possible.

For example, the performance of a typical clinical action such as taking a surgical patient's history could not happen contemporaneously with logging actions into the PDA. Nor could the trainee, in the event when he or she was in the company of the surgical team examining patients in the wards, be audacious enough to pull out his or her PDA from his or her pocket to read, take notes or log his or her actions. Apart from the issue of audacity, work-integrated learning – which relies on direct practice and observation – would not take place in such an instance.

It was clear that the conditions of use and, to a lesser extent, the nature of the custom applications did not allow them to use the PDAs to serve the information management (organizational) motive for which it was deployed. Trainees' mobility around hospital wards, direct practical training and observation were the significant conditions surrounding technology use.

"Assuming I have to deal with 5 patients, the slowness of the application's response implies that I have to spend about 10 minutes with each patient … it's not realistic in a clinical setting" – a trainee.

It was also clear that, even in its near-flawless state, the custom application still could not have been used in the clinical setting because of the nature of the mobile learning activity and the trainees own mobility required thereof. In fact, even for the three custom applications, the trainees could use them quite successfully when they were not conducting clinical duties and when they were less mobile.

"It's not complicated, it's just too time-consuming. I just can't use it. If I could use it per patient, then that would be fine, but per activity, it's out of question. It's too time-consuming so I'm just not going to use it. To do each patient, I reckon it would take something like half-an-hour to input the data which would be mad. It's just not feasible to do it like that." – a trainee.

Interestingly, the trainees reported that outside the clinical (problematic) conditions, the technology could be used because in such unproblematic conditions, there was sufficient time and virtually no clinical demands to stifle technology use. However, we must remember that information capture was sanctioned to be done *during* the training, during the clinical activities, and not afterwards. Computing during the activity was key to documentation and ultimate accreditation of the training exercise. These results show that more physical work undermines virtual working with a portable artifact and vice versa. From the information management (organizational) perspective, therefore, the technology was declared a failure by both the trainees and the training project manager. It was therefore not surprising when he officially called for the abandonment of the PDA as a tool for information management.

However, it is interesting to note that alongside the failure perception, the trainees also reported that the PDA was becoming an excellent personal organizer which many of them could not "live without." I received these reports during and after the project. 'Living without' was expressed in varieties of personal uses. Some had experienced success with the calendar, some with the address book, some with the task scheduler and some with Nevo®, the TV remote controlling application on the PDA, and some went to the extent of downloading applications such as pocket dictionaries and e-reader. They claimed that the standard applications had proven to be extremely useful as far as their personal uses alongside their training contexts were concerned. In the final analysis, the learners were ambivalent towards the PDAs. Thus, although the case clearly shows that mobile computing was inflexible and a failure in the sanctioned learning activity, it is noteworthy that the learners' final evaluation and perception of the PDA as a "wonderful" tool was indicative of its satisfaction of their personal motives.

6 Appropriation of the PDA

In respect of this description, the intriguing questions are *(1) what are the dynamic motivations and conditions which engender the user's success-and-failure perception of a mobile technology? (2) what are the implications of this perception for user acceptance of mobile technology?* I will unveil the dynamics underlying the success-and-failure perception of the artifact through an analysis of the appropriation of the artifact based on the conditions of its use, on its use to serve organizational or personal motives, and on its design properties.

6.1 Motives and Mobile Conditions

The training project was extremely volatile and ambitious, and its implementation would undoubtedly be characterized by crucial challenges in terms of mobile computing. It would be work-integrated, activity-based, conducted in distributed locations, function under the direct control of surgical staff and hence out of immediate control of the project team, highly locally mobile, confrontational, and unstable. Since it was a mobile and distance learning exercise, it was imperative for the project team to institute measures to control – to scaffold, monitor and coordinate – the trainees' distant actions. Upon this, the PDA was deemed an efficient controlling and stabilizing tool through the trainees' use for actions logging and reflections writing. Mobile computing was therefore envisioned to serve the motive of the sanctioned learning activity (organizational motive); and it was to serve as a *tool*. Note, however, that as a tool, it would confirm that conditions of the mobile activity have ensured its status as a tool; and its use would represent a subconscious operation. As a tool, it would figuratively represent a transparent screen through which the subject could see the learning object and transform it. In adverse conditions, however, the technology would be an *object* to compete with the learning activity for the learner's consciousness or attention. As an object, it would represent an opaque device standing in-between the subject and object: its use would represent another action with a potential to displace the learning activity; and, undoubtedly, the learner would maintain the learning activity at the expense of using the *object*, that is, of the mobile computing "activity."

This means that the trajectory of the PDA's use (between success-and-failure) was situated within the learners' mutating perception of the technology as a tool or object depending on the conditions of the activity it was mediating and the motive behind the

activity. Evidence from the project suggested that, in terms of the learning activity, the device represented an object, an opaque piece of equipment, which interfered with the learners' clinical routines and contravened its initial tool-functionality. Extreme local mobility of the trainees and their training that embodied safety-critical clinical actions were one set of conditions that partly made the PDA appear as an object which manipulation the trainee had to forgo due to the pre-eminence of the motive behind the learning activity. Thus, in terms of the motive driving the learning activity, the PDA was deemed as a failure because it was more an object than a tool; and its use (mobile computing) would have constituted another competing activity. As the empirical example shows, the technology was only deemed as a success (as a tool) by the trainee when he or she was using it to serve a personal motive. This was because the achievement of a personal motive – such as personal organization with the calendar and task scheduler – occurred in more favorable conditions. Such conditions entailed less human mobility and were more conducive for mobile computing. As I have indicated, however, the use conditions and motives were not the only factors that determined success-and-failure of the artifact; its design properties, both standard and custom, inscribed by both manufacturer and the project manager were also determinants.

6.2 Design Properties and Inscriptions

Success-and-failure was also rooted in and embodied by the strength of inscriptions (Akrich 1992) of the project manager. The framework for learning actions and reflections that underpinned the design of the three different applications was grounded on pedagogical principles to surrogate the project manager's monitoring and instructions from the training center in London. Given the motive of surgical care skills acquisition cum the assumption

of junior doctors' functions cum the satisfaction of accreditation and acceptability requirements, the pedagogical rules underlying the clinical actions and reflections framework were instructive and objectivist-oriented. Hence, the custom applications designed into the PDAs were characterized by strong inscriptions of the project manager's desired patterns of expected use by the learners. These attributes of instructive learning – such as control, monitoring, scaffolding, and facilitation – were all inscribed into the PDAs based on implicit and explicit assumptions about the technology's capacities for providing mobile computing services.

The reality was that instead of logging clinical actions after the completion of every act, the learners, on realizing the impracticality of such computing actions, used paper-based logging sheets and later transferred these into the PDA when they returned home. Instead of writing reflections-on-action at the end of every day's learning, most of them wrote them weekly; worse still, they wrote on paper before typing into their PDAs. Worst of all, many of them even found it more convenient to perform these computing actions on their desktop computers and subsequently synchronize them into the PDA. Conceptually, we can say that the trainees followed an *anti-program* (Latour 1991). These counter-actions were performed to alleviate the imposition and intrusion associated with the custom applications; that is, they *de-scripted* (Akrich 1992) the inscribed remote-controlling measures of the project manager – not rebelliously, but in their instinctive orientation towards flexible computing.

6.3 Flexibility of Mobile Computing

The failure of the technology under the custom applications and its success under the standard applications suggest that the learning conditions were as accountable for anti-

programming and de-scripting as the design properties. In truth, the trainees' interpretation of the applications built into the PDA, leading to a mix of success-and-failure perceptions, was premised on the flexibility of mobile computing. Flexible computing is a function of the motive being supported, of the condition underlying use, and of the technology's design properties. High flexible computing in terms of any activity context reflects a scenario in which technology use is enabled by ideal design properties and conditions to support the motive driving the activity. In this scenario, the technology will be perceived as a tool. Conversely, in a low flexible computing scenario, the technology will be perceived as an object. Thus in low flexible computing, the PDA was perceived as an object by the trainees. As an object, if it ever satisfied a need, the trainee's motive to transform it (the need) was implicit in his or her appropriating the PDA into a tool; and its tool perception could only manifest in less mobile, non-organizational and less imposing conditions – after work, on the way home, and at home, as they reported.

When technology use is not the motive itself but a support for the motive, the user will desire and strive continuously for high flexible computing because technology-as-tool is easier to use than technology-as object. Over the course of the work-integrated learning project, this striving for high flexible computing on the part of the learners was obvious; and circumstances of low flexible computing, symbolising failure, were continuously being substituted for higher flexible computing circumstances. Given that the project-use of the PDA was deemed a failure and personal-use a success, the process of appropriation can be explained by the continuum between the two contexts of uses (see Figure 2).

Insert Figure 2 about here

The PDA was appropriated by being perceived and used as a tool; but a tool for serving personal motives of the trainees contrary to the originally purported tool for the training activity. In short, mobile computing services could not be sourced from the PDA to serve the learning motive as intended. In reality, the learners followed an *anti-program*, they *de-scripted* the strong inscriptions, and they *drifted* from the control structures designed into the technology. Anti-programming, de-scripting and drifting are concepts that denote scenarios in which actual technology use patterns deviate from the designer's intended use patterns.

7 Discussion

The main reason why organizations deploy mobile computers to support mobile activities is to facilitate information management on-the-move. This means that optimization of a deployed mobile computer lies in its use *in* mobile activities at specific times and places (Cousins and Robey 2005) and for particular purposes. Because optimization is an intrinsic aspect of the achievement of the motive driving the mobile activity, the conditions underlying use will shape the optimization. Thus, conditions such as modes of mobility [micro or local or remote (Luff and Heath 1998)] and the nature of mobile work [e.g. Policing (Sørensen and Pica 2005)] do not only shape mobile computing; they can, at the same time, undermine the process. This is why the use of a portable computer in conditions outside those of the mobile activity nullifies its usefulness by virtue of the motives driving that activity. Therefore, in mobile computing, the use condition, is a

determinant of appropriation because of requirements for use at specific times and places and for particular purposes.

The interesting aspect about appropriation is that the same portable technology that is deemed appropriable in non-organizational conditions (personal context) may be deemed useless by the same user in organizational conditions; and vice versa. It is also noteworthy that the diversity of executable applications in the technology suggests that some will be more supportive of personal motives and others more supportive of organizational motives. This means that portable technology design properties also determines appropriation. In sum, it can be said that the (absolute) appropriation of a portable technology lies in the user's drift from a scenario of adverse conditions and suboptimal technology properties in an organizational context to a scenario of favorable conditions and optimal technology in a personal context. This drift, at the same time, makes the technology change from non-appropriable in terms of the organizational motive to appropriable in terms of the personal motive. The opposite argument (from personal to organizational context) is true. It is true because, although the notion of appropriation signifies making something one's own, appropriating a portable technology to support organizational motives can manifest when the user's personal motive coincides with the organizational motive, conditions and design properties permitting.

The notion of absolute appropriation subsumes a zero-appropriation which is the ideal scenario in which the portable computing is appropriable in both personal and organizational contexts. In this scenario, arrangements are such that applications, conditions and motives support both personal and organizational motives fully. In this scenario, there would be no drift from one state of appropriation to another, no co-existing

success-and-failure perceptions, and mobile computing will be highly flexible in both personal and organizational contexts. This implies that organizations that adopt and deploy portable technologies to support mobile activities must strive towards this ideal to achieve absolute user acceptance of those technologies.

These discussions that evince the crucial role of motives and conditions in understanding portable technology use underline the importance of the activity perspective. Appropriation of portable technology and mobile computing flexibility, which are essential constructs of the activity perspective, resonate with the most prominent models of technology use – social construction of technology (Bijker et al. 1987, Bijker 2001), and with the structurational model of technology use (Orlikowski 2000, DeSanctis and Poole 1994). This resonance lies in the idea that all of them talk about use of technology that deviates from inscribed structures due to factors within the context of use. At the same time, appropriation, which represents a more elaborate empirical analysis of the processes in individual usage of portable technology, differs from existing models because in such models, the exegesis of technology use is confined to objective (or organizationally-sanctioned) settings; and the implications of differences between personal and organizational motives are overlooked. Such confinement and oversight leave unexplained the impact of personal contexts on user acceptance of technology.

My rendition of the appropriation of portable technology does not preclude social construction of technology. In other words, portable technology can also be socially constructed. In fact, an essential aspect of appropriation is that it can be an antecedent or consequence of social construction. As a consequence, it would represent a deviation from an erstwhile social construction by different people in different contexts, reflecting an ideal

(Ilyenkov 1977). Ideals engender beliefs and such beliefs about the promise of portable technologies are common among organizations which activities are mobile. But when such technology is deployed in a mobile activity and the mobile user's judgment of its functional essence happens to be anything apart from the ideal, appropriation would result. On the contrary (as an antecedent), since appropriation is a conceptualization based on an individual's judgment of a portable technology's functional essence (according to the motive it is serving), it is possible for the judgments of several individuals who form a group to coincide or for judgments of a majority of them to coincide. If these individuals interact to communicate their judgments, their individual judgements can be transformed into a social construction (Berger and Luckmann 1967, Searle 1995).

The point I am making, however, is that appropriation as a concept is individual-user-based, and that the concept is most applicable to mobile individuals' use of portable computers in mobile activities. We are talking about the same portable technology being used by the same user, but which can engender contrasting perceptions; and the question is, how and why are these perceptions engendered? Social construction tells us that, surely, technology will be perceived differently from its preconception. However, it does not tell us, first, about how and why portable technology will be perceived differently from its preconception, second, about how and why individual users do this, and, third, in which contexts such different use patterns will even engender these perceptions. Appropriation, as I have explained, overcomes these limitations.

In the case of the structurational model of technology, constructs such as embedded structures (DeSanctis and Poole 1994), enacted structures, intentions and situated use (Orlikowski 2000, p. 407) reflect, respectively, design properties, appropriation, motives,

and conditions in my conceptualization. The model has been very useful in improving our understanding of ongoing changes in technology and use. However, while it talks about the role of intentions and conditions in shaping technology judgments, it does not differentiate between personal and organizational motives, nor does it explain the implications of such differences on technology use. Besides, its explanations of different conditions largely border on technological and institutional dimensions, rendering them insufficient for analyzing portable technology use conditions that lie outside the organizational space.

My conceptualization also resonates with Sørensen and Pica's (2005) conceptualization of portable technology use in police work. They argue that the mobility of police work is constituted by a cyclical interplay between virtual work (mobile computing) and physical work (actual policing without mobile computing); and this interplay generates police workers' "rhythms of interaction" with their portable technologies. Thus, portable computer use is a reflection of situational aspects and the institutional context of work. Likewise, appropriation relates with Sarker and Wells' (2003) discussion of the factors that determine portable computer use and adoption in mobile commerce. Among a host of factors, they also talk about modalities of mobility and socio-economic context as determinants of adoption and use. However, both of these explanations of portable technology use in mobile work differ from my perspective in the sense that they preclude use in personal situations, and how personalization affects the mobile worker's perception of portable technology. That is, their conceptualizations, just like others' of technology use, are centered exclusively on objective or organizational circumstances of mobility.

The research by Sheepers and associates (2006) on how personal contexts influence user satisfaction with mobile computing seems to overcome the preclusion of personal

contexts that characterize Sørensen and Pica's and Sarker and Wells' works, thus aligning closest with my own in this paper. My conceptualization is in harmony with Scheepers and associates (2006, p.266) in terms of their argument that "specific consideration should be given to all the relevant individual use contexts that are pertinent to mobile technology. This is because the physical mobility of the technology and the new contexts of individual use, by way of mobility, demand a more dynamic conceptualization." However, we differ in the sense that Scheepers and his associates did not elaborate theoretically (as my conceptualization in this paper does) on how and why individual use contexts shape user satisfaction. My conceptualization details the collective roles of motives which mobile computing serves, of dynamic use conditions, and of design properties in shaping user acceptance and satisfaction.

The appropriation of portable technology is, essentially, an epistemology of individual user behavior (mobile computing) anytime anywhere (Kleinrock 1996). This conceptualization resonates with Weick's (1979) insistence that our theorizing of behavior must transcend "organizational" settings to include behavior outside such settings because "sensitivities of the worker inside are continuous with sensitivities of the worker outside" (p.31). Expressing his uneasiness about the phrase "organizational behavior," he points out that "behavior is behavior;" and thus, "rather than searching for unique behaviors that occur within an organization and then building a theory about this uniqueness, it seems more useful to build theories about the particular ways that enduring individual dispositions are *expressed* in an organizational setting, and to build theories about the effects of this expression" (p.32, emphasis in original). Weick's point is mostly true in the theorization of mobile computing in mobile activities because users' mobile computing in organizational

contexts is very intertwined and continuous with the same behavior outside organizational contexts. My theorization of how portable technology users' dispositions in personal and organizational contexts affect their satisfaction with the technology confirms his point.

7.1 Implications for Research and Design

Research: The preceding arguments shape up into relationships between the various factors which have dominated the analysis – human mobility, motives, conditions, technology design properties, appropriation and flexibility of mobile computing. Following Orlikowski's (1992) and Davis and colleagues' (1989) call, it is important for this paper to contribute to a better understanding of portable technology use that will help in predicting and improving user acceptance in IS research and practice. Thus, I condense these relationships into a conceptual model which suggests a framework for analyzing mobile computing in mobile activities and for ascertaining the flexibility of mobile computing (see Figure 3). My analysis and discussion suggest that portable technology use in mobile activities should be deemed as the basic unit of analysis of the appropriation of portable technology. The two – portable technology and mobile activities – must be analyzed together as a conjoined unit to appreciate how motivations, conditions and design properties affect users' judgment of the technology's functional essence. In other words, how they determine the degree of appropriation.

Appropriation can be a continuous back-and-forth variable because flexibility of mobile computing is a continuous concept. In reality appropriation can manifest also in terms of the user's drift from low flexible mobile computing in personal circumstances to higher

flexible mobile computing in organizational circumstances. This explains why conditions, motives and design properties must be isolated for consideration in analysis.

Insert Figure 3 about here

Although the role and impact of motivations, conditions and design properties in shaping portable technology use must be considered in tandem, analysis will necessitate their individual considerations to understand which factor is more determining, and so on. In analysis, efforts must be made to appreciate the particular conditions that underlie the use of the technology. Therefore, it is important, for example, for the analyst to bear in mind that because of human-and-technology mobility, use conditions will vary to and fro between organizational (mobile work) contexts to non-organizational (personal) contexts. It is also important for the analyst to appreciate the extent to which the technology's systemic, physical and interface design properties are affecting its use. Finally, it is important to know what motive is being or not being served in which particular conditions, and this is the crux of appropriation because motivation is an important aspect of users' judgment of the functional essence of portable technology.

The model is an important analytical tool because, through an understanding of how and why appropriation of portable technology occurs in any context, one can also understand how and why appropriation of the same technology could not manifest in the other context. This understanding is likely to reveal a deficiency in conditions or design properties or both, and can be used to explain technology failure. The deficiency can also

be used to revise organizational motives and conditions, as well as designed applications in practice.

Design: The appropriation of portable technology portends on the design of portable technology applications that are acceptable to users. And the greatest strength of the concept lies in its capacity to help improve user acceptance of portable technology. Ciborra (2002, p.109-110) talks about technology as an ambiguous stranger that needs "hospitality" by the user, suggesting that user adaptation and appropriation are important components of technology use. This implies that user's appropriation of technology to serve personal motives is a useful starting point for his or her acceptance of the technology. The user's "hospitality" towards portable technology can be enhanced through the support it provides him in his or her personal (non-organizational) circumstances. Appropriation in both organizational and personal domains of use points to the idea that design of portable technology applications oriented at users' personal motives can be a catalyst for their acceptance of the technology for organizational motives. Since personalization is an essential aspect of portable technology use and hence of user acceptance, it is almost imperative for portable technology champions in organizations to advocate for the inclusion of applications which users can customize to serve their personal motives.

This approach to design, to a large extent, conforms to the ideals of the socio-technical systems design school; that is, to their ETHICS method. Students of this school, led by Mumford (1980, 1995) have championed the ETHICS method which aims to achieve a better balance between technology and people in the design and use of working technology. At the core of ETHICS is a strong advocacy for users to benefit personally from organizational technologies by balancing technology efficiency and social objectives from

conception through design to implementation. Thus, the concept of appropriation, that has strong implications for satisfaction of users' personal motives and even of those motives outside organizational settings, can inform ETHICS from design to implementation. The difference that appropriation makes in relation to ETHICS is that, again, the technology in question is portable and can be used in both organizational and personal contexts by the same user. This implies that, user satisfaction ideals of ETHICS such as consultation and participation in portable technology design should aim at prototypes that satisfy both organizational and users' personal motives.

8 Conclusion

In this paper, I have proposed an activity perspective on portable technology use. I have attempted a new conceptualization of portable technology use through analysis of the appropriation of portable technology. I have argued that the flexibility of mobile computing is dependent on this appropriation in both organizational and personal domains of use. While existing conceptualizations of technology use have focused on computing in organizational domains, on static technologies and on collocated activities, such conceptualizations are insufficient for predicting use and improving user acceptance of portable technologies. Thus, this conceptualization contributes to our understanding of portable technology use by incorporating mobile activities, motives behind use, dynamic conditions or contexts of use, and the design properties of technology, towards IS researchers' and practitioners' prediction and improvement of user acceptance of portable technology.

References

Adams, D. A., R. R. Nelson and P. A. Todd (1992) "Perceived Usefulness, Ease of Use, and Usage of Information Technology: A Replication" *MIS Quarterly,* **16 (2),** pp. 227-247.

Akrich, M. (1992) "The De-scription of Technical Objects" In *Shaping Technology/Building Society,* (Eds, Bijker, W. E. and Law, J.), MIT Press, Cambridge, MA, pp. 205-224.

Baskerville, R. J. (1999) "Investigating Information Systems with Action Research" *Communications of the AIS,* **2 (19)**.

Baskerville, R. L. and A. T. Wood-Harper (1998) "Diversity in Information Systems Action Research Methods" *European Journal of Information Systems,* **7,** pp. 90-107.

Berger, P. L. and T. Luckmann (1967) *The Social Construction of Reality: A Treatise in the Sociology of Knowledge,* Penguin, Harmondsworth.

Bijker, W., T. Hughes and T. Pinch (1987) *The Social Construction of Technology Systems,* MIT Press, Cambridge, MA.

Bijker, W. E. (2001) "Understanding Technology Culture through a Constructivist View of Science, Technology and Society." In *Visions of STS: Counterpoints in Science, Technology and Society Studies.,* (Eds, Cutliffe, S. H. and Mitcham, C.), State University of New York Press, New York, pp. 19-34.

Boudreau, M.-C. and D. Robey (2006) "Enacting Integrated Information Technology: A Human Agency Perspective" *Organization Science,* **16 (1),** pp. 3-18.

Ciborra, C. U. (2002) *The Labyrinths of Information: Challenging the Wisdom of Systems,* Oxford University Press, Oxford.

Cousins, K. C. and D. Robey (2005) "Human Agency in a Wireless World: Patterns of Technology Use in Nomadic Environments" *Information and Organization,* **15 (3),** pp. 151-180.

Davis, F. D. (1989) "Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology" *MIS Quarterly,* **13 (3),** pp. 319-340.

Davis, F. D., R. P. Bagozzi and P. R. Warshaw (1989) "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models" *Management Science,* **35 (8),** pp. 982-1003.

DeSanctis, G. and M. S. Poole (1994) "Capturing the complexity in advanced technology use: Adaptive structuration theory" *Organisation Science,* **5 (2),** pp. 121-147.

Eisenhardt, K. M. (1989) "Building Theories from Case Study Research" *Academy of Management Review,* **14 (4),** pp. 532-550.

Engeström, Y. (1987) *Learning by Expanding: An Activity-Theoretical Approach to Developmental Research,* Orienta-Konsultit, Helsinki.

Geisler, C. (2003) "When Management Becomes Personal: An Activity-Theoretic Analysis of Palm Technologies" In *Writing Selves/Writing Societies Research from Activity Perspectives,* (Eds, Bazerman, C. and Russell, D. R.), Colorado State University, Fort Collins, CO.

Goodhue, D. L. (1995) "Understanding User Evaluations of Information Systems" *Management Science,* **41 (12),** pp. 1827-1844.

Goodhue, D. L. and R. L. Thompson (1995) "Task-Technology Fit and Individual Performance" *MIS Quarterly*, **19 (2),** pp. 341-356.

Goodwin, N. C. (1987) "Functionality and Usability" *Communication of the ACM*, **30 (3),** pp. 229-233.

Hamill, L. and A. Lasen (Eds.) (2005) *Mobile World: Past, Present and Future*, Springer-Verlag, London.

Ilyenkov, E. V. (1977) "The Concept of the Ideal" In *Problems of Dialectical Materialism*, (Ed, Ilyenkov, E. V.), Progress, Moscow.

Kleinrock, L. (1996) "Nomadicity: Anytime, Anywhere in a Disconnected World" *Mobile Networks and Applications*, **1 (4),** pp. 351-357.

Kristoffersen, S. and F. Ljungberg (2000) "Mobility: From Stationary to Mobile work" In *Planet Internet*, (Eds, Braa, K., Sørensen, C. and Dahlbom, B.), Studentliteratur, Lund, pp. 41-64.

Latour, B. (1991) "Technology is Society Made Durable" In *A Sociology of Monsters: Essays on Power, Technology and Domination*, (Ed, Law, J.), Routledge, London.

Leont'ev, A. N. (1978) *Activity, Consciousness and Personality*, Prentice Hall, Englewood Cliffs.

Leont'ev, A. N. (1981) *Problems of the Development of the Mind*, Progress Publishers, Moscow.

Luff, P. and C. Heath (1998) "Mobility in Collaboration" In *Proceedings of the The ACM 1998 Conference of Computer Supported Cooperative Work (CSCW '98)*, Seattle, WA, USA.

Lyytinen, K. and Y. Yoo (2002) "Research Commentary: The Next Wave of Nomadic Computing" *Information Systems Research,* **13 (4),** pp. 377-388.

MacKenzie, D. and J. Wajcman (Eds.) (1985) *The Social Shaping of Technology: How the Refrigerator Got its Hum,* City University Press, Milton Keynes.

Marx, K. and F. Engels (1976) "The German Ideology" In *Collected Works, Vol. 5,* (Eds, Marx, K. and Engels, F.), Progress Publishers, Moscow.

Mumford, E. (1980) "The Participatory Design of Clerical Information Systems: Two Case Studies" In *The Human Side of Information Processing*, (Ed, Bjùrn-Andersen, N.), North-Holland, Amsterdam.

Mumford, E. (1995) *Effective Systems Design and Requirements Analysis: The ETHICS Approach* Palgrave MacMillan, Basingstoke.

Orlikowski, W. J. (1992) "The Duality of Technology: Rethinking the Concept of Technology in Organizations" *Organization Science,* **3 (3),** pp. 398-427.

Orlikowski, W. J. (2000) "Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organisations" *Organization Science,* **11 (4),** pp. 404-428.

Rice, R. E. and E. M. Rogers (1980) "Reinvention in the Innovation Process" *Knowledge: Creation, Diffusion, Utilization*, **1 (4),** pp. 499-514.

Rogers, E. M. (1995) *Diffusion of Innovations,* Free Press, New York.

Sarker, S. and J. D. Wells (2003) "Understanding Mobile Handheld Device Use and Adoption" *Communication of the ACM,* **46 (12),** pp. 35-40.

Scheepers, R., H. Scheepers and O. K. Ngwenyama (2006) "Contextual Influences on User Satisfaction with Mobile Computing: Findings from Two Healthcare Organizations" *European Journal of Information Systems,* **15 (3),** pp. 261-268.

Schein, E. H. (1987) *The Clinical Perspective in Fieldwork,* Sage, Thousand Oaks, CA.

Schön, D. A. (1983) *The Reflective Practitioner: How Professionals Think in Action*, Basic Books, New York.

Schutz, A. (1954) "Concept and Theory Formation in the Social Sciences" *The Journal of Philosophy,* **51 (9),** pp. 257-273.

Searle, J. (1995) *The Construction of Social Reality,* Free Press, New York.

Sørensen, C. and D. Pica (2005) "Tales from the Police: Rhythms of Interaction with Mobile Technologies" *Information and Organization,* **15,** pp. 125-149.

Tsoukas, H. (1989) "The Validity of Idiographic Research Explanations" *Academy of Management Review,* **14 (4),** pp. 551-561.

Vygotsky, L. S. (1978) *Mind in Society: The Development of Higher Psychological Processes*, Harvard University Press, Cambridge, MA.

Waycott, J. (2005) "Appropriating Tools and Shaping Activities: The Use of PDAs in the Workplace" In *Mobile World: Past, Present and Future*, (Eds, Hamill, L. and Lasen, A.), Springer-Verlag, London, pp. 119-139.

Weick, K. E. (1979) *The Social Psychology of Organizing,* McGraw Hill, New York.

Weick, K. E. (1989) "Theory Construction as Disciplined Imagination" *Academy of Management Review,* **14 (4),** pp. 516-531.

Weilenmann, A. (2001) "Negotiating Use: Making Sense of Mobile Technology" *Personal and Ubiquitous Computing,* **5 (2),** pp. 137-145.

Wiberg, M. and F. Ljungberg (2001) "Exploring the Vision of "Anytime, Anywhere" in the Context of Mobile Work" In *Knowledge Management and Virtual Organizations*, (Ed, Malhotra, Y.), Idea Group Publishing, pp. 157-169.

FIGURES

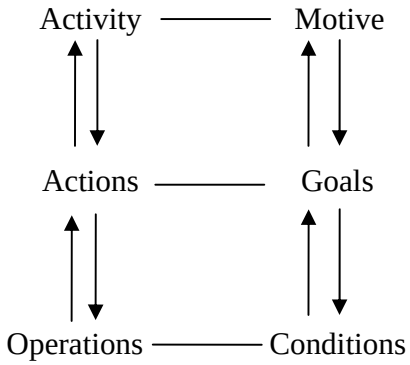

Figure 1: General Structure of an Activity

[Source: Leont'ev (1978)].

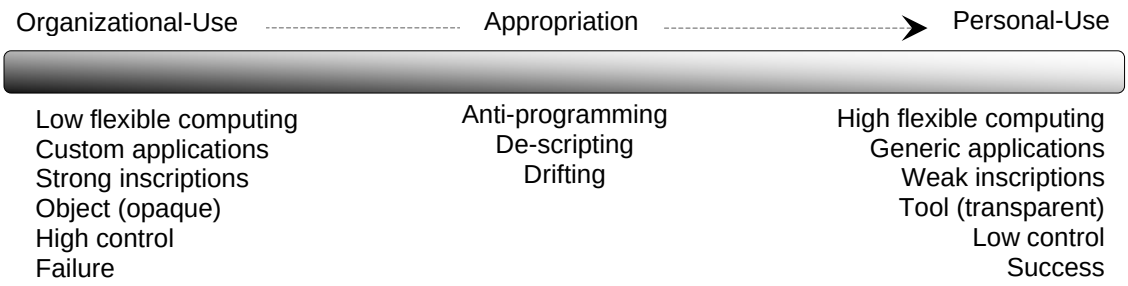

Figure 2: Appropriation of the PDA from low flexible computing in organizational circumstances towards high flexible computing in personal circumstances.

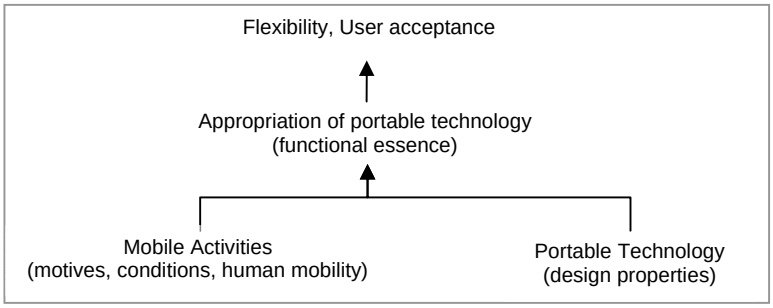

Figure 3: Conceptual model for analyzing the flexibility of mobile computing in mobile activities