

**Computing in Everyday Life:
A Call for Research on *Experiential Computing***

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Abstract

The IS discipline emerged as a new discipline of artificial science as a result of intellectual efforts to understand the nature and consequences of computer and communication technology in modern organizations. As the rapid development of digital technology continues to make computers and computing a part of everyday experiences, we are once again in need of a new discipline of the artificial. In this essay, I argue that the IS community must expand its intellectual boundaries by embracing what I call *experiential computing* in order to fill this growing intellectual void. Experiential computing involves *digitally mediated embodied experiences in mundane activities through everyday artifacts that have embedded computing capabilities*. Experiential computing is enabled by the mediation of four dimensions of human experiences (time, space, actors and artifacts) through digital technology. From an analysis of the basic principles of experiential computing, I suggest six research opportunities that the IS research community can explore. Ultimately, I propose the IS field returns to its roots of the science of the artificial by decisively expanding the scope of its inquiry by embracing computing in everyday life experiences.

Keywords: Experiential Computing, Radically Convergent Digital Environments, Phenomenology, Ubiquitous Computing

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Three Tales of *Another* IT Revolution

The story of iPod and iPhone

Since its introduction in October 2001, Apple Computer has sold over 173 million iPods. In the final quarter of 2008 alone, over 22.8 million iPods were sold. Over this same period of time, Apple also sold over six billion songs through its iTunes music store, causing a fundamental reshuffling in the music record industry (Levy 2006). Combined with thousands of third-party accessories, sales of the “iPod ecosystem” were estimated to exceed \$1 billion in 2006 (Darin 2006). The combination of the popularity of iPod and web-based content distribution mechanisms such as RSS (real simple syndication) and weblogs (or simply blog) led to the emergence of podcasting – a new form of audio and video file distribution over the Internet. Podcasting has become a major disruptive innovation in broadcasting, as listeners and viewers can choose to listen to and watch the subscribed contents whenever and wherever they want. Leading academic institutions have begun using podcasting as a way to distribute a wide variety of materials - not only the students but also to the public.

Recognizing the disruptive potential of podcasting, many broadcasting companies are now providing their contents in a podcast format. Some newspapers such as the New York Times have begun providing some of their popular content in a podcasting format, blurring the traditional boundary between newspaper printing and broadcasting. In June 2007, Apple introduced the iPhone, which combines the iPod, phone, GPS (Global Positioning System), and digital camera, all in a single mobile computing device running a variant of the Unix operating system. Within a very short period time, iPhone spurred the development of thousands of mobile applications that combine mobility, social networking and multi-media, fundamentally changing the way people interact with the mobile phone and Internet.

The story of OnStar

Originally developed by a group of graduate students in computer science and business administration who were working for IBM's ExtremeBlue internship program, General Motor's (GM) OnStar was introduced to the market in 1996 as a safety tool for luxury cars. Over time, GM has added more features and functions to OnStar, and has expanded its availability to less expensive models as well as its competitors, thus opening up the new field of *telematics* services. Along with other computing capabilities embedded in the car, the introduction of telematics services has increased the complexity of computing tasks in the average car. According to Tony Scott, former Chief Technology Officer of GM's Information Systems and Services, in an average GM car, in 1970 there were 100,000 lines of software code; by 1990, that number had grown to one million lines, and is expected to grow to 100 million lines of code by 2010. In comparison, Windows XP has about 40 million lines of code. According to Scott, GM has become "a system integrator as much as it is an assembler of parts." The rapid convergence of global positioning systems (GPS), digital mobile technology, in-car navigation and entertainment systems and on-board microprocessors make it possible to design novel services, not only for in-car entertainment and navigations, but also to meet insurance, safety and maintenance needs, all of which can offer a very different driving experience to the drivers and the passengers. This has fundamentally influenced the way the car is designed as manufacturers are struggling to integrate various forms of computing capabilities into the existing car platforms (Henfridsson and Lindgren 2005).

The Story of Camera Phone

In November 2000, Sharp Corporation in Japan introduced H-SH04, the world's first camera phone – a mobile phone equipped with a built-in camera. It received widespread skepticism for its low image quality, the lack of periphery support such as flash and built-in memory, its small viewing screen, unacceptable battery performance and the lack of integration with other technologies. Yet, today more than 2/3 of the mobile phones sold worldwide are equipped with a built-in camera. Some camera phones

easily outperform typical digital cameras, boasting extremely high resolution. By the end of 2004, the sales of camera phones outstripped the sales of digital and film-based cameras combined. By 2006, Nokia had become the world's largest digital camera manufacturer simply because of the number of camera phones that they produce. Combined with high-speed mobile data connection and the increasing popularity of so-called Web 2.0 services that allow users to share contents and meta-contents, camera phones have become an important social technology. A video clip captured on a mobile phone showing a university professor illegally instructing students to vote for a government candidate, combined with the effective use of text-messaging among anti-government young voters, fueled the Orange Revolution in Ukraine in November 2004. In June 2005, a passenger on a subway in Seoul, South Korea, took pictures of a girl who did not clean up the excrement from her puppy and posted those pictures on a popular Internet site for digital pictures (Krim 2005). Over the days that followed, her pictures appeared on hundreds of personal blog sites, with thousands people engaged in a witch hunt, trying to find out her identity. In a few days, her personal identity was revealed and new pictures of her carrying the puppy in a subway appeared again on the Internet sites. She is now known as "Dog-Poop-Girl," which appears as an entry in the wikipedia.com, an on-line encyclopedia. Eventually she was forced to take a voluntary leave from her university.

Every way we turn, we see information technology. Everywhere we go, we are constantly surrounded by computers. We use them when we talk, listen to music, drive our cars, and take pictures. T-shirts and jeans that come with radio frequency identification (RFID) tags remind us that our everyday life is fully saturated with advanced information technology. Yet, as shown above, they are not computers in a beige box that provide computing experiences to corporate computer users. Instead, they are portable music players, cars with navigation systems, or mobile phones with digital cameras and data access. Nor do we see users in a traditional sense. Instead, we see music lovers, drivers, and subway passengers. These people participate in mundane everyday activities.

This is a different kind of IT revolution. While the IT revolution that brought integrated enterprise resource planning systems, global supply chain management, and virtual teams to organizations has received significant attention from the information systems (IS) community, the type of IT revolution mentioned above has so far garnered much less attention by the mainstream IS research community. Yet, by no means is this a less significant IT revolution. In fact, when people commonly think of an IT revolution in everyday life, it is precisely this type of *IT revolution* that they likely would think of first. While IS scholars recently began exploring the adoption and use of IT in a non-work context (Hong and Tam 2006; Venkatesh and Brown 2001), a decisive majority of IS research still deals with the *organizational* use of IT and its consequences. Furthermore, few studies that deal with non-work IT use draw on the same theoretical framework that is used to study organizational IT use. The ubiquity of IT in our lives suggests that we do not leave computers behind when we leave our workplaces. This means not only that the boundary between work and life has become blurred, but also that computing has deeply penetrated our life beyond our work, whether we conduct our work in the office or at our home. We continue to carry computers in our pockets, in our car and even in our clothes long after we turn off our computers after work. This is a puzzling phenomenon. Why doesn't the IS community study IT-enabled phenomena that is so pervasive throughout, and relevant to, society? Further, how can we as a community approach this important topic, leveraging our own unique perspectives and intellectual traditions?

In this paper, I argue that the IS community has not been able to effectively study this important topic, partly because it requires a fundamentally different approach to computing as compared to traditional organizational computing summarized by Orlikowski and Iacono (2001). As such, when we attempt to study this emerging phenomenon using the traditional approach to organizational computing, we are not able to effectively capture this rich and dynamic socio-technical phenomenon. In this paper, I argue that this type of emerging computing phenomenon in everyday life is based on a different computing ontology that is based on phenomenology (Boland 1985; Mingers 2001). I also argue that both the behavioral science and design science communities in the IS discipline must expand their respective

domain in order to fill the current intellectual void. In order to do this, I propose the notion of *experiential computing* as a way of going forward. Experiential computing is defined as *digitally mediated embodied experiences in mundane activities through everyday artifacts with embedded computing capabilities*. By mundane activities, I mean non-computing activities that we do to sustain our daily lives. By everyday artifacts, I mean non-computer artifacts with which we interact. As I will discuss later, experiential computing is enabled by the mediation of all dimensions of human experiences through digital technology.

In what follows, I will first discuss the two major factors that contribute to the emergence of experiential computing. This is followed by the major differences between experiential computing from more traditional computing experiences and a more formal discussion of experiential computing. I conclude the paper by proposing potential avenues for future IS research.

Computing in A Changing World

Two distinctive, yet interconnected, forces contribute to the emergence of experiential computing: ubiquitous computing technologies and the emergence of new users of computing.

The emergence of ubiquitous computing technologies

The continuing miniaturization of computer and communication hardware, combined with ever increasing processing power, storage capacity, communication bandwidth and more effective power management, has made the vision of ubiquitous computing very close to reality (Lyytinen and Yoo 2002b; Sørensen et al. 2005; Weiser 1991). Although traditional general-computers will never disappear, the rapid advances of technology bring fundamental changes in the ways in which we interact with computers.

An important technological development is tangible computing (Dourish 2001; Ishii and Ullmer 2000) or physical computing (Igoe and O'Sullivan 2004). Instead of employing traditional input and output methods, users interact directly with the system by physically manipulating objects. Although the

majority of these modes of interactive computers are still in the early stages of experimentation, applications that use haptic input devices for gaming¹, medical simulation and training, and collaboration have already emerged (Ben-Joseph et al. 2001; Cai et al. 2006; McConnon 2007). These devices use the physical movements of our bodies as the input and use direct bodily experiences as the output of computing.

At the same time, computers are increasingly coming out of the beige box and moving into everyday artifacts. Consumer products such as refrigerators, TVs, telephones, and stationary bicycles are equipped with computing capabilities that connect to the Internet. Digital photo frames are directly connected to Internet photo sharing service sites to support the sharing of pictures among friends and family. We can only expect that this type of embedding of computing capabilities into everyday artifacts will increase as the integration of digital capabilities into these products becomes increasingly feasible, both technologically and economically.

These digitalized everyday artifacts can form an ad hoc network and connect to global information infrastructures through communication technologies. Digitalized devices can interact with sensors that track their movements and send and receive information. Users of such ‘smart artifacts’ can then connect with other users in a different place and time while they physically interact with the artifact in their own context. Overlaying such digital information upon familiar artifacts creates new usage possibilities and expands the meanings of everyday activities. For example, the combination of a stationary exercise bicycle with a computer and a broadband Internet connection can turn an otherwise simple individual physical activity into an activity that has many layers of meaning. Not only can the connected computer provide additional health-related information, the system can potentially provide massive multi-player game interactions with other *bikers*, transforming the experience of riding a stationary exercise bicycle from an individual physical experience to a collective social experience. Similarly, by integrating sensors made up of membranes that respond to a liquid stream in a typical urinal,

¹ Nintendo Wii is based on the physical manipulation of haptic devices.

MIT Media Lab researchers created an interactive urinal system (Maynes-Aminzade and Raffle 2003). The users of the urinal can “score” high points by aiming more accurately. The urinal system comes with an LCD screen that shows a game-like interface. The system can turn an otherwise solitary physical experience into an interactive and social experience.

The connection of artifacts with the global information infrastructure also expands the way we consume them. For example, a software program called Delicious Library™ allows users of Apple personal computers with a webcam to scan the bar code of a book or a CD to retrieve all the information about it available on Amazon.com, including reviews and ratings from other readers, current prices for new and old copies, and recommendations for future purchases. Similarly, an application for Android, a mobile phone developed by Google, allows users to use their camera phones to scan the barcode of a product to check the price at other local stores. In both examples, physical products with minimum embedded information are used to retrieve a broader set of information from the Internet. One can expect more radical forms of such transformations if and when books and other physical products come with two-dimensional barcodes and RFID tags.

The combination of sensor networks and the global information infrastructure will also create smart buildings and smart cities. In such places, computing capabilities will be distributed and hidden in the walls, doors, windows and floors (Mitchell 1999). These *invisible computers* will interact with computers in our pens, watches, phones, desks, cars, and computers (desktops and laptops). Such embedded computing environments (Lyytinen and Yoo 2002a) are likely to change the way we experience the environment. Recently, Microsoft has announced Surface, a tabletop computer that interacts with human touch and artifacts that have special bar codes. Although similar technologies have existed for years in laboratory environments (Ullmer and Ishii 1997), the introduction of these digitalized artifacts into our living rooms will likely alter the meanings and patterns of familiar social interactions. The vision of a *digital urban environment* is being implemented with a combination of location-based WiKi, mobile clients, and a sensor network (Calabrese et al. 2007; Riva and Borcea 2007; Sohn et al. 2005), taking the notion of community-computing to the next level (Carroll and Rosson 2003).

In summary, the combination of tangible computing, the digitalization of everyday artifacts, sensor networks and a global infrastructure make the vision of the “Internet of Things” an imminent possibility. As computing capabilities become ubiquitously distributed throughout our everyday life experiences, users are enabled to store, mobilize, and interpret the types of information that were not readily available in the past, opening up a vast new vista of opportunities.

New Users of Computing

Recently, IS scholars have begun re-examining the notion of users. In particular, Lamb and Kling (2003) articulate why the traditional notion of users is not broad enough for the reality of contemporary organizations. They argue that the traditional notion of users as atomic individuals who focus on task performance using information systems as an aid for their cognitive processes does not capture the complex social reality of organizational computing. The traditional notion of users underpinning the IS research tends to attenuate the importance of contextual and environmental factors, and emphasizes the abstract representations of task and its information requirements with narrowly defined interactions between the user and the systems. In response, Lamb and Kling demonstrate that users of information systems are embedded in much more complex and diverse socio-technical environments. They propose the social actor as an alternative way to conceptualize users. They note that users of information systems are socially embedded in networks of relationships that mobilize the exchange of information and the use of information systems.

In this paper, I suggest to push the expansive view of users proposed by Lamb and Kling even further forward by anchoring it more deeply in our everyday life. They correctly point out that users are enmeshed in networks of relationships by performing their tasks in *organizations and* processing their *information needs*. However, as computers become more embedded in everyday artifacts and activities, even their view of users as social actors in organizations fulfilling their informational needs is too restrictive.

In experiential computing, the notion of users needs to be expanded across three critical dimensions. First, users of experiential computing are not necessarily *organizational members*, but rather ordinary individuals outside of the organizational context. This does not mean that users do not use computing capabilities for organizational purposes. Instead, this indicates that users will interact with computing technologies in a much broader social context, assuming diverse social roles such as family, friend, and neighbor. In particular, a new generation of users who spent their entire lives surrounded by and using computers, video games, digital music players and mobile phones -- so called 'digital natives' (Prensky 2001) -- use computing capabilities for much broader purposes than the previous generations of 'digital immigrants.' While in the past, users' acceptance and training might have been important issues in IS research, these issues will become irrelevant to the emerging generation of users for whom the notion of technology acceptance will be assumed.

Second, users of experiential computing will interact with computers as well as everyday artifacts that have embedded computing capabilities. These artifacts are often incorporated into an ensemble of other tools (both digital and non-digital) in the *durée* of everyday life. Access to and use of these artifacts are constantly negotiated and re-negotiated, as opposed to a conventional computing usage pattern where users could afford to pay attention exclusively to a computer.

Finally, users of experiential computing do not use artifacts only for their information needs. Instead, computing capabilities are used in order to enhance a much broader set of experiences in performing mundane activities such as running, driving, and listening. Unlike traditional computing where the use of an artifact requires interpretations of symbolic representations, whether they are numbers, graphics, or texts, in experiential computing, artifacts with embedded computing capabilities directly mediate the user's experience (Ihde 1990). Therefore, experiential computing calls for a reorientation of our focus from task performance and information processing to lived experiences of everyday life activities that are digitally mediated. User needs are therefore much broader than informational needs for task performance in organizations, thus reflecting deeper basic human needs and values.

As computers become integrated into mundane activities through everyday artifacts that these new users utilize and are surrounded by (Grudin 1990), it is more meaningful to think about *computing* as a verb than computers as a noun. Furthermore, computing through these everyday artifacts will not be a dedicated activity that is the primary focus of a user's attention. Instead, computing will often take place on the periphery of other activities. Such changes in the notion of computers and computing challenge traditional assumptions underpinning IS research, which often puts computers at the center of our discourse (Benbasat and Zmud 2003; Orlikowski and Iacono 2001). This is not to deny the central importance of computers in IS research going forward. The issues and challenges on which traditional IS research has focused in the context of organizational computing as a set of separate activities will continue to have relevance. In short, we suggest that we in the IS research community have an opportunity to expand our research domain by embracing the ubiquitous impact of computing in everyday life.

Experiential Computing: An Organizing Framework

What do I mean by experiential computing? First of all, I do not mean computing experience. Certainly experiential computing is a kind of computing experience, but there exist other forms of computing experiences. The idea of experiential computing can best be explained with the backdrop of two alternative forms of computing experiences: *representational computing* and *imagined computing*.

Alternative Forms of Computing Experiences

Representational computing draws on the Cartesian separation of mind and body and attempts to map actors and artifacts into representational symbols for further interpretation, manipulations and processing. Here, the Cartesian separation of mind and body, self and the world, and knowledge and activity are essential, unchallenged assumptions. This mode of computing is based on what Ihde (1990) refers to as the *hermeneutical relationship* between technology and users. That is, users are required to

interpret symbols that are produced by the technology. For instance, Ihde uses the example of reading a thermometer in a room that shows the outside temperature in cold weather. A user who reads the thermometer experiences the cold weather through his interpretation of the sign (whether it is a mercury bar or numeric digits) on the thermometer. But the user does not directly feel the cold on his skin. Much of the previous IS research focuses on representational computing experiences. According to a review by Orlikowski and Iacono (2001), viewing IT as a tool, computation or some other proxy variable have been the three dominant perspectives in IS research in the past. All three perspectives reflect the Cartesian dichotomy. Therefore, traditional IS research is mostly concerned about representational computing. It is the domain of the entity-relationship diagram and data flow diagram. This is the computing experience that we gain by viewing screen of a desktop computer and interacting through a keyboard and a mouse. In representational computing, the computer is a critical tool or a part of an assemblage of resources that users explicitly draw on in performing the task.

Imagined computing draws on what Ihde (199) refers to as an *alterity relationship* between technology and users. In the imagined mode of computing, users interact primarily with computers as an end in itself. This is the world of computer games and virtual reality, e.g., SecondLife and the World of Warcraft. Avatars in a virtual world may take a completely different identity from the owner who may have several avatars at the same time. Many of the digital products and buildings in the virtual world exist only in the realm of the imagined. Unlike representational computing, which is meant to be a representation of the world using digital symbols, the construction of imagined computing does not need to be constrained by the reality of the world. In fact, the disconnection from the real world might be one of the attractions for users of imagined computing. The artifacts of imagined computing rest on the foundation of representational computing, which serves as a generative platform for giving birth to a world of avatars, digital buildings and digital products. Imaginary computing is gaining interest in the IS community, as evidenced by a Special Issue of *MIS Quarterly* on 'New Ventures in Virtual Worlds' that is in development.

Conceptual Framework of Experiential Computing

Contrary to representational computing and imagined computing experiences, experiential computing builds on the notion of the *embodiment relationship* between technology, world and people (Ihde 1990). The notion of *embodiment* finds its roots in the philosophy of phenomenology (Boland 1985; Heidegger 1962; Merleau-Ponty 1962; Mingers 2001). Embodiment is “the property of being manifest in and of the everyday world” (Dourish 2001). Here, the social and physical reality is something that is not experienced through abstraction, but rather is experienced directly. Instead of the world being out there and understanding it through abstract representations using symbols, *I am in the world* and my existence in the world shapes the way I understand it (Heidegger 1962). The embodiment underscores the importance of physical, direct and existential participation in the world in which we live. In the embodiment relationship, technology mediates our lived experiences. As a contact lens wearer sees the world *through* contact lenses, technology in the embodiment relationship comes between the user and the world. Technology is not being interpreted, nor is it being experienced as an end in itself. Instead, it transforms our lived experiences.

Drawing on Dewey (1934) and Merleau-Ponty (1962), I conceptualize the embodied human experience as an interaction between our body and the environments characterized by four dimensions: time; space; and other actors and things (including the natural world). Experiential computing then rests on the possibility of complete or partial mediation of the four dimensions of lived human experiences by digital technology. Figure 1 shows a schematic framework of experience as a consequence of interactions between a subject and the world which in turn is defined across four dimensions (time, space, other actors and artifacts).

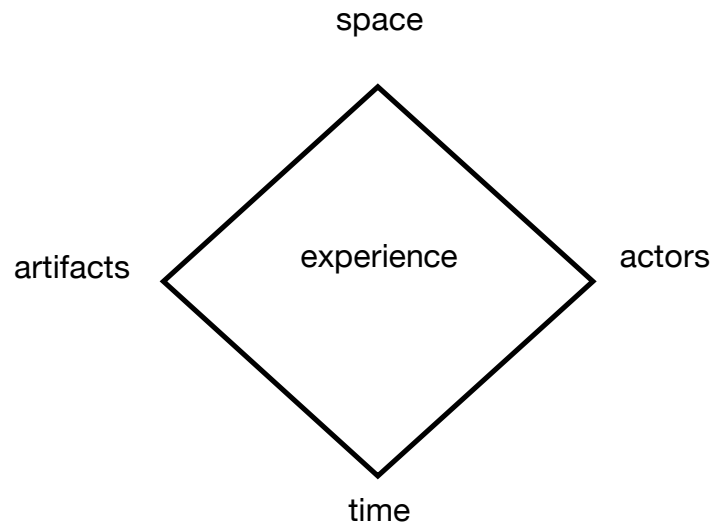


Figure 1. Schematic Framework of Experiential Computing

Four Dimensions of Experiential Computing

The digitally mediated experience begins with our body, which exists in *space*. We can never experience things independent of our experiences as a bodily engaged being in the world. Then, it is by virtue of our embodiment that we can experience things as being up or down, as having insides or outsides, as being close or far away. Space is always in relation to my body as situated within the world. The body can only be present *here*, as an anchor of our lived experience. Space is not just a sort of ether where things are arranged, but it is a structure that enables things to be connected as we experience them. We then never experience space as a passive collection of facets and objects. Instead, experiences of space come into our consciousness and are shaped by the *constructive* and *intentional* activities of embodied, situated perceptions both simultaneously and successively.

Similarly, we experience *time* through our body. We can never be at two places at once. We are always situated in the *now*, on the way somewhere as having been somewhere. Thus, our digitally mediated experience is always temporary and in the process of becoming. According to Merleau-Ponty (1962), the embodied experience of time is not a line that is strung together by a series of discrete moments, but a network of intentionalities. That is, our experience of time takes place at the intersection

of two trajectories of intention: our anticipation of what is to come and our retrospections (and reconstructions) of what has been (Davis 2003). The spatiotemporal experience becomes the basis of our embodied experiences, as indeterminate and dynamic.

In this spatiotemporal context that is temporary and unfolds over time, we come to experience *artifacts* (and the natural world) and other social *actors*. The digitalization of artifacts can take the simple form of tagging by RFID chips or two-dimensional bar codes (such as a QR code) to more sophisticated sensor networks and embedded computing. Using simple mobile devices or embedded sensors, digitalized information pertaining to the artifacts in the physical world (be it a tree, a building, a car or a toaster) can be retrieved and used to mediate user experiences in interacting with the artifacts themselves. Furthermore, these digitalized artifacts can “interact” and be associated with other artifacts in a similar way that users of Web 2.0 services can re-mix and associate different contents created by different users.

Finally, the digitalization of actors already has been accomplished in part by the proliferation of social networking sites. Here, the informal and formal relationships among users are digitalized in the form of social networks, such as Facebook, MySpace or LinkedIn. The relationships on these social networks are not simply representations of existing social relationships. They *are* relationships of a different kind. Furthermore, the current form of associations among actors that exist in these social network sites can be expanded in several different ways. Currently, most popular social network sites use friendship networks in order to build associations among users. We have already begun seeing the development of technology that allows similar associations based on location (association among people who are in the same location), time (association among people who engage in the same activity during the same period time), artifacts (association among people who use the same tools), or any combination thereof. For example, DOPPLR connects people who travel to the same destinations and links the user’s friends’ network to other popular social network sites.

The digitalization of these four dimensions of human experience form the basis of experiential computing. Unlike traditional computing users, the users of this new form of experiential computing will

not necessarily see computing as an activity that is separate from their everyday activities. In fact, all they do may be just everyday activities. Similarly, computers often will be forgotten by the users in experiential computing. Here, computers are hidden from the users in music players, cars, buildings, trees and desks. The goal of the new computing paradigm is not to represent the world, but to construct a better world in which we live. The computing experiences are created, stored, actuated and experienced through conventional computing tools as well as through actors, ordinary artifacts, and places. We no longer experience computing as something that is out there, but rather we live *in* it.

IS Research Opportunities in Experiential Computing

The contemporary society is an ‘artificial’ world, a world that is shaped by artifacts (Dahlbom 2002; Simon 1996). These artifacts are increasingly being digitalized, embedding powerful computing capabilities. These digitalized artifacts play decisive roles in shaping and mediating all dimensions of our lived experiences. Yet, there is a serious intellectual void that needs to be filled to understand exactly the nature and the consequences of the digital mediation of human experiences. Disciplines in traditional social sciences are not well equipped to understand the transformative power of digital technology. Science and engineering disciplines are not too concerned about the human experience. The IS discipline was born as a new discipline of artificial science precisely out of the intellectual void at the time when digital artifacts (e.g., computers and communication technologies) were beginning to transform modern organizations (Iacono and Kling 2001).

Now, our discipline is at another pivotal moment as the scope of digital technology grows beyond the organizational realm. The expansion of the influence of digital technology provides a critical opportunity to expand the intellectual boundaries of the IS research community beyond the traditional focus of organizational computing. With a newly expanded domain of inquiry, we should study *the nature and consequences* of the digital mediation of everyday experiences. Studying the transformation of everyday experiences allows us to draw on a strong intellectual tradition in the IS discipline that

examined the consequences of organizational work practices and structure through the use of information technology (DeSanctis and Monge 1999; Hevner et al. 2004; Iacono and Kling 2001; Orlikowski 1993; Robey and Sahay 1996; Sambamurthy and Zmud 2000; Straub and Watson 2001). The IS community has developed a rich repertoire of theoretical language and methodological tools to study IT-enabled changes. These theories and methodological tools do not have to be confined within the boundary of organizational change. As digital technology continues to expand its influence on everyday experiences, IS scholars can employ these theoretical and methodological tools to study how we construct and reconstruct our world -- an artificial world -- and thus shape our experiences. This is a call to return to the roots of our discipline as a science of the artificial that deeply engages in the design of the artificial world. The aim of this section, therefore, is to urge the expansion of the scope and the direction of IS research I by embracing what I refer to as experiential computing.

There are several different ways to conceptualize IS research. In this study, in an effort to build a cumulative tradition, I adopt a research framework developed by Hevner et al (2004). Their framework is also appealing as it tries to include both behavioral and design sciences as two primary modes of inquiry in information systems research. By adopting their framework, I will sketch out research opportunities for both behavioral science and design science researchers. As shown in Figure 2, experiential computing takes place in increasingly digitalized everyday contexts. The goal of IS research on experiential computing is to develop and test theories and build and evaluate artifacts in order to meet basic human needs by using our research to shape digitalized everyday environments through new theories and artifacts.

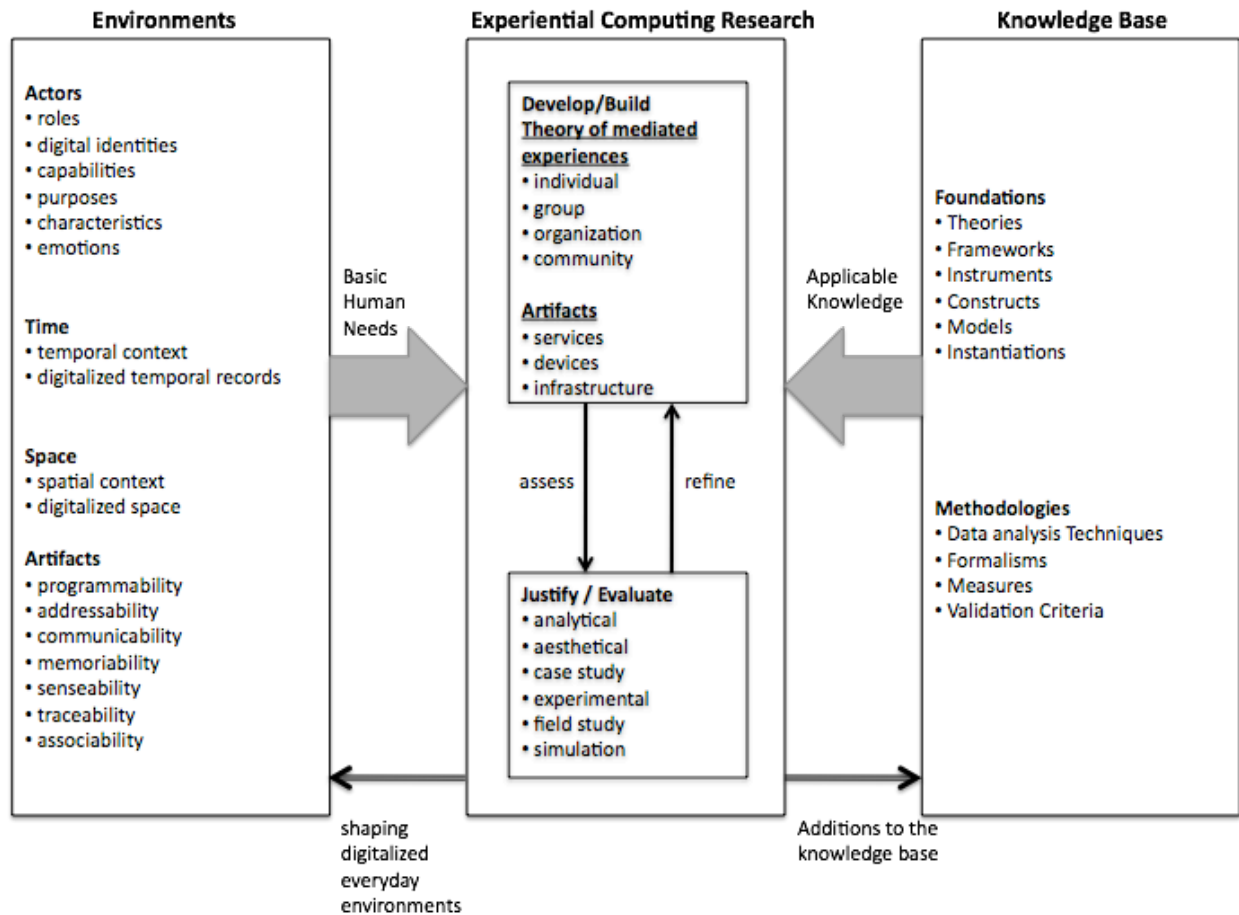


Figure 2. Experiential Computing Research Framework [Adopted from Hevner et al. (2004)]

Theory Development and Testing: Opportunities for Behavioral Science

At the core of theory development and testing for experiential computing is the idea of digitally mediated everyday experiences. Four different levels of theories need to be developed: individual; group; organizational; and community. The intent here is not to develop an exhaustive list of future research opportunities for behavioral science. Instead, it is to demonstrate how different approaches (positivistic, interpretive, an economic) within the behavioral science tradition can contribute to the development and testing of new theories on different aspects of experiential computing.

First, at the individual level, we need to develop new theories on how digitally mediated experiences are shaped. Lakoff and Johnson (1980) offers a useful place to start. They note that our experience emerges from interactions with the physical and cultural environments. Thus, experiences in

their most basic form can be viewed as inherently interactional properties. They further provide four dimensions of interactional properties that shape our experiences of interacting with artifacts: perceptual, motor-activity, functional and purposive. *Perceptual property* is how they look and feel. *Motor-activity property* is what we do with our body in order to interact with the artifact. *Functional property* is what the artifact allows us to do. Lastly, the *purposive property* is the intended purpose of the tool. Applied to digitalized artifacts, the first two deal with physical materiality; the latter two deal primarily with digital materiality inscribed into the physical tools through software. As experiences emerge from interaction with artifacts, experience is not entirely objective, shaped by the materiality of the artifacts. Nor is it entirely subjective, solely shaped by our own agency. Recently, materiality of technology is gaining growing interest among IS scholars (Leonardi and Barley 2008; Orlikowski 2007; Orlikowski 2008). One of the key insights from the materiality discourse is the dialectic negotiation of resistance and accommodation between technology and actors (Pickering 1993). Past studies on materiality often focus on functional property (under the name of affordances) and purposive property, often instantiated as software-based digital materiality. Experiential computing will require us to consider physical materiality primarily coming from perceptual and motor-activity properties in addition to these two properties. Thus, we need to theorize the mangling of two different forms of materiality -- digital and physical -- and the agency of individual users and how they come to shape everyday life experiences. A particular challenge in theorizing experiential computing in this context is the fact that we often interact with the world in constantly changing contexts, using multiple tools simultaneously. Unlike the traditional computing context where users interact with a single computer, in digitally mediated environments, individuals are likely to interact with multiple tools at the same time. We will need precise theoretical language to theorize such contexts.

Another major area that needs individual-level theory development is how digital technology influences our experience of time and space. It has been noted that the emergence of the global information infrastructure led to time-space distancing (Giddens 1990). The evolution of modern

communication and transportation technology has “lifted up” social life from the here and now, causing a divorce between time and space. The emphasis in the literature has been the emergence of the sense of *space* out there that is boundless and global (Castells 2003; Giddens 1990; Schultz and Boland 2000). To the contrary, experiential computing brings us back to a *place* of here and now. When we engage in everyday activities, our experiences do not happen somewhere out in a virtual space. Instead, they happen in a *place* with the urgency of now. There is no denying the important and transformative consequences of time-space distancing in information technology, as has been argued in the IS literature. What I am arguing here, instead, is that the emergence of experiential computing in our everyday life will force us to pay closer attention to what is happening immediately around us. The emphasis of place does not mean that we are going back to the pre-modern configuration of time and space. Instead, I believe we will have to think more carefully about the emergence of a new meaning of place with digital technology mediating our experience of material surroundings. The focus should be how technology “pulls down” the digital representations into the immediate activities in the material world of here and now.

Finally, Dourish (2001) notes that “the source of meaning (and meaningfulness) is not a collection of abstract, idealized entities; instead it is to be found in the world in which we act, and which acts upon us” (p. 116). Therefore, as the material environment with which we interact is augmented with the digital technology that mediates our experiences, the fixity of the meaning of familiar everyday activities is dissolved. Thus, with the emergence of digitally mediated environments, we need to explore the transformation of the meaning of everyday activities.

Research Opportunity 1: How does the mangling of two forms of materiality -- digital and physical -- and human agency influence digitally mediated experience in everyday life? How does the use of multiple and heterogeneous digital artifacts in the durée of everyday life shape digitally mediated experiences? How do digitalized environments affect our experience of time and space? How do digitally mediated experiences transform the meanings of familiar everyday activities?

Second, the exploration of experiential computing becomes more complicated when we consider the fact that we often use digitalized tools with others. This suggests that we need a new set of theories focusing on small group behaviors in digitally mediated environments. We may orient ourselves toward an artifact as we interact with others who may or may not be co-present. As many of our social interactions are mediated and shared through digital media (listening to music, watching video clips on a small mobile device, playing games and exchanging text messages), understanding how our embodied experiences are shaped through subtle but constant negotiations with others as we orient ourselves toward these artifacts is critically important. The intrusion of new digital artifacts in the public place can change the meaning of the place as the addition of these new digital tools can alter the way we orient toward other actors who are co-present. For example, the proliferation of portable MP3 players that can play music and video may ultimately cause the death of the family room when individual family members relate to each other differently as they form different couplings with new digital devices. Similarly, we are already seeing the transformation of daily commuting experiences with public transportation systems as people use small mobile devices to chat with their friends and family, catch up on their favorite TV shows, or tweet their commuting experiences with pictures taken from their mobile phones. Here, we see a complex tension between togetherness and solitude in a shared space within a highly mobile context over a relatively short period of time. In an exploratory study, Bassoli et al. (2006) design a mobile music sharing system in the London Underground Tube system where commuters can upload and download music files at different stations and then share them anonymously while in the carriages of the tube. People can browse the music's origination point (where it was first uploaded) and what songs are popular at which station. Therefore, the system allows people to see a journey through the tube as a flow of people and music. The implementation of a digitally mediated environment in the tube network can change the experience of daily commuting. Theories in social cognition literature (Ickes and Gonzalez 1994; Levine et al. 1993) that examined the impact of the presence of others on an individual's perceptions and

behaviors and distributed cognition theories (Boland et al. 1994; Hutchins 1995) will be most relevant for this opportunity.

*Research Opportunity 2: How does the shared use of digital artifacts shape small group experiences?
How does the use of digital artifacts in a public space change the dynamics of solitude and togetherness?*

Third, experiential computing can open up new research agendas at the organizational level as well. This will likely happen in collaboration with disciplines that deal with new product development and innovations. In the past, much of IS research on the strategic and organizational impact of technology has primarily focused on corporate information systems either as a strategic asset or a complementary asset (Clemons and Row 1991; Sambamurthy and Zmud 2000). Given the root of the field that came from studying the issues related to *management information systems* managed by a corporate IS department, it is natural that the field of IS has a strong affinity for the corporate IS organizations that provide various IT-based services for managerial purposes. Experiential computing, to the contrary, concerns the use of computing resources both within and beyond managerial and organizational boundaries. The goal of this paper is not to undermine the importance of organizational computing, but rather to suggest that we need to radically expand the scope of our intellectual inquiry to research various issues and opportunities that arise as organizations try to embed various forms of digital technology into their products and services.

Recently, there is a growing acknowledgment that IT innovation can directly influence the way firms innovate and thus create strategic disequilibrium in the market place (Fichman 2004; Lyytinen and Rose 2003; Swanson 1994; Swanson and Ramiller 1997; Swanson and Ramiller 2004). Extending this line of work in IS literature, IS researchers need to continue to look more directly and broadly into product development and innovations (Banavar and Bernstein 2002; Fano and Gershman 2002; Henfridsson and Lindgren 2005). This implies a couple of important new intellectual challenges that the IS community can address. First, the design and construction of experiential computing services and products that take advantage of digitally mediated experiences require integration across previously separate industries and product lines. When Nike and Apple introduced the convergence of running shoes

and MP3 players, this created a challenging knowledge integration problem. As traditionally non-digital products and services have very different life-cycles and customer expectations, the way those products and services are designed and implemented require a very different infrastructure and set of knowledge resources. Therefore, a key theoretical challenge in providing experiential computing products and services will be the management of heterogeneous resources that are essential to designing and delivering radically convergent digital environments (Yoo et al. 2008). The extent literature on knowledge management – particularly that which deals with knowledge diversity (Andersson et al. 2008; Boland et al. 2007; Kanawattanachai and Yoo 2007; Malhotra et al. 2001) – can be a useful starting point in examining this line of work.

Furthermore, the digitalization of products and services will likely affect the organizational structure and identity. Sennett (2008) notes the reciprocal relationship between an actor's identity and the artifacts that he uses and produces. The technological malleability and social heterogeneity of digital technology will make digitalized products generative -- the capacity to produce unprompted changes driven by uncoordinated and heterogeneous actors (Tuomi 2002; Zammuto et al. 2007; Zittrain 2006). As digitalized products become more generative - and thus their innovations become more unbounded - the organizational challenges to manage the innovation process will become increasingly non-linear and complex (Boland et al. 2007; Van De Ven et al. 1999).

Finally, experiential computing can also help us expand existing theoretical work on the IT-enabled work practice transformation (Leonardi 2007; Malhotra et al. 2001; Orlikowski and Scott 2008) as these new technologies bring different forms of materiality. For example, in the context of the healthcare industry, past IS research has examined the evolution of patient record management. Increasingly, however, information technology is being used not only to deal with patient records, but to heal patients. Digital imaging, ad hoc sensor network, RFID, and mobile computers are just few examples where advanced information technologies are becoming deeply entrenched in the practices of healthcare service providers. The design of these devices and the management and information infrastructure used to

support these devices will have significant implications for the healthcare industry. Experiential computing can provide a vantage point for IS researchers to study such digital convergence and the consequent transformation of work practices in healthcare contexts.

Research Opportunity 3: How do organizations manage the heterogeneity of required knowledge resources in producing new products and services, leveraging digitally mediated environments? How does the digitalization of products and services affect organizational structure and identity and what is the role of generativity of digital technology in that process? How will digitally mediated environments transform existing work practices?

Fourth, at the community level, IS scholars can develop new theoretical perspectives on the transformation of communities as a result of experiential computing in several different ways. First, the emergence of digitally mediated everyday experiences offers an opportunity to reshape theories on local community. An early glimpse of the vision of integrating digital technology into a physical community can be found in early models of community-based computing networks started in 1970s when communities like Berkley (Farrington and Pine 1996), Cleveland (Beamish 1995) and Santa Monica (Rogers et al. 1994) started building community-oriented networks out of local activism. Those early community-based networks covered a range of social challenges including housing, jobs, health, homelessness and education (Carroll and Rosson 2003). In the 1990s, the World-Wide Web became the basic infrastructure and organizing framework for the second-generation community-based network. One of the most prominent examples is the Blacksburg Electronic Village (BEV) project (Carroll 1996; Carroll 2005). The early community computing models were based on an abstract representational mode of computing, with little or no connection to the physical places. With more recent developments of digital mapping technologies, sensor networks, digital tagging of physical locations and artifacts, and smart mobile devices that can interact with these digitalized artifacts, one can envision a complex hybrid network of people, places, artifacts, tools, and contents (both public and user-generated) being formed as a result of on-going interactions among them. These hybrid networks will enable us to build and test new

network-based theories on community and large collectives. Computational sociology and network-centric social and economic theories will provide a useful starting point for this line of inquiry (Lazer et al. 2009).

Second, digitally mediated environments give us an opportunity to develop new theories and language that deal with the multiplicity of the meaning of public space. The use of digital forms of data (a map, photos, or written text) retrieved from multiple venues offers the opportunity for formal and informal information to coexist, thus enriching the experience of a place. A location-based WiKi, for example, can be built to create a channel for these voices (Calabrese et al. 2007; Carroll and Rosson 2003). Diverse voices, alongside an official narrative, about the place offered through representational and imagine realms can *democratize* the experience of the public sphere. Similarly, technologies like ZoneTag (<http://zonetag.research.yahoo.com/managezt.php>), which allows users to tag digital photos that they take with certain keywords along with geo-location information of the place where the pictures are taken, allow a group of users to collectively build meanings of a particular place (Kennedy et al. 2007). An analysis of such keywords shows the collective, temporal and dynamic construction of the meaning of public space.

Research Opportunity 4: How does experiential computing change the way we experience community? What are the new theoretical lenses through which we might study the structure and dynamics of hybrid network people, places, artifacts, tags, and contents and how do such networks influence the way collective community behaves? How does a digitally mediated environment transform the way we experience the public sphere aesthetically, cognitively, culturally and physically? How does experiential computing allow the emergence of the multiplicity of meaning of public place?

Building and Evaluating Artifacts: Opportunities for Design Science

Experiential computing also provides new opportunities to develop design theories and validate them through the construction and evaluation of new artifacts. Below, I will discuss two such

opportunities.

First, as familiar everyday artifacts are digitalized, we need to understand the necessary and desirable material properties of these digitalized artifacts and the ways in which we may evaluate these artifacts. This requires us to develop a new set of design theories and test them through constructing and evaluating digitalized artifacts. While the development of the complete and exhaustive list is beyond the scope of this paper, we can begin to think about what properties need to be instantiated in these digitalized artifacts. First, at the most fundamental level, increasingly powerful, small, and low-power consuming microprocessors and communications technologies make it possible to embed software capabilities into what used to be non-digital artifacts. Using these embedded computing capabilities, non-digital artifacts become *programmable* (ITU 2005), performing multiple functions and making them more malleable. Second, the implementation of microprocessors, RFID chips and two-dimensional bar codes into everyday artifacts will make them *addressable*. That is, each digitalized artifact can be uniquely identified in a computing architecture. Along with programmability, addressability of these artifacts will enable these digitalized artifacts to be enrolled into the global information infrastructure, such as Internet. Third, the integration of small sensors into everyday artifacts and places will make them *sense-able* and equipped to collect different types of information. Sense-able artifacts and their users will form the edge of the infrastructure that is constantly evolving. Fourth, these digitalized artifacts can interact with other digital artifacts, infrastructures, and actors through embedded digital communication capabilities. Combined with sense-ability, the communicability of digitalized artifacts will enable new forms of relationships between actors and artifacts. For example, a recent New York Times article reports that individuals are connecting various types of sensors to a Twitter account² in order to monitor the natural environment, homes, and even movements of a fetus in a mother's womb. Thus, these digitalized artifacts will be *communicable*. Fifth, most of these digitalized artifacts will have some type of memory capacity, either on their own or through a network. This will make these digitalized artifacts *memorize-able*. Therefore, these digitalized artifacts will be able to remember where they were, who used them, the

² Twitter (<http://twitter.com>) An internet-based short text message broadcasting service up to 140 characters.

outcomes of the interactions, etc. Sixth, sense-able and memorize-able artifacts and relationships among these artifacts and users will produce massive amounts of digital trace for their conditions, movements, and interactions with others. Therefore, these digitalized artifacts become *traceable* in time and space. Finally, recent developments in Semantic Web (Berners-Lee et al. 2001) enable information associated with actors, artifacts, places and events to become *associable*, making folksonomy possible. This enables a radically de-centralized form of organizing of computing resources possible with a minimum of centralized control. Yet, this requires a stable set of standards and an interface that supports distributed coordination among independent actors and artifacts. These seven properties of digitalized artifacts – programmability, addressability, sense-ability, communicability, memorize-ability, traceability and associability – along with other properties that future research will identify need to be carefully theorized in order to be implemented in artifacts.

Studying the construction and evaluation of digitalized artifacts in everyday life contexts implies that the evaluation criteria of these artifacts need to be expanded. In the current design science paradigm (Hevner et al. 2004; March et al. 2000), the evaluation of artifacts is based on feasibility and efficiency. While these two will continue to be important, the evaluation of digitalized everyday artifacts will also require another important criteria, desirability. The rapid development of digital technologies makes it feasible for us to digitalize all forms of experiences. Further, we may be able to do it more efficiently. Yet, not all digitally mediated experiences are desirable. Desirability requires us to consider how humanistic values such as ethics, aesthetics, ergonomics and environmental responsibility among other factors as we evaluate digitalized artifacts (Buchanan 2004).

Finally, the construction and evaluation of digitalized artifacts in the context of everyday life is perhaps one of the most direct ways that the IS community can participate in the construction of the artificial world (Boland and Collopy 2004; Dahlbom 2002; Simon 1996). Therefore, the design science approach to experiential computing must put a premium on imagination -- a capacity to think of what is not there. Imagination is a key ingredient in our ability to transform the current situation into a more

desirable one, which is the goal of any design (Boland and Collopy 2004; Simon 1996). Therefore, design theory needs to involve more disciplined imagination as Weick describes the essence of theorization (Weick 1989). Here, a theory is primarily a logical device that we use to construct a new sociotechnical reality. This calls for a different form of scholarship (Dahlbom 2002; Flyvbjerg 2001; Latour 2005; Van De Ven 2007). Such an emphasis will bring inevitable tension into design science given its emphasis on analytical rigor (March et al. 2000).

Research Opportunity 5: What are new material properties that are necessary and desirable in constructing and evaluating digitalized everyday artifacts? How can one consider feasibility, efficiency and desirability at the same time that we evaluate digitalized artifacts? How do we develop design theories and a theorization process that simultaneously value analytical rigor and disciplined imagination?

Second, experiential computing requires the support of a robust and ubiquitous information infrastructure. Both technical and managerial issues related to infrastructure have been an important part of IS research and will continue to be so (Lyytinen and King 2006; March et al. 2000; Star 2002; Star and Ruhleder 1996). The study of experiential computing can contribute to this line of research by studying dynamic and diverse computing capabilities that are needed for experiential computing. Experiential computing will require not only the artifacts that have computing capabilities, but also environments that are populated with sensors and network connectivity. Two particular issues will emerge as important research opportunities for design science researchers. First, the design and construction of digitally mediated environments that become the technological basis of experiential computing need to support the design properties of digitalized artifacts, some of which we discussed above. While the emerging service-oriented architecture and other related standards are beginning to address many of these aspects, many technical challenges still remain ahead. At the same time, many of the challenges will be non-technical, although they are technically implemented (Lyytinen and Yoo 2002b). Organizations that want to provide services and products for experiential computing will deal with complex issues that deal with

interoperability, standards, revenue sharing, data ownership, etc. Second, the study of experiential computing will also point out the necessary but difficult convergence of the information infrastructure into another physical and cultural infrastructure. As the technology moves deeper into our everyday life, the issue of infrastructure convergence will become even more important.

Research Opportunity 5: How does a tight coalescence across material, representational and imagined realms of world create new technical and social challenges in designing and managing a digital infrastructure? How can a digital infrastructure be integrated into another existing physical and cultural infrastructure? How can organizations design and deploy a digital infrastructure that meets both the immediate and unforeseen future needs of a heterogeneous set of user communities?

Concluding Thoughts

Experience is an essential aspect of our existential struggle. It is our experiences that shape our identity, ideals, and worldview. In this essay, I have made the argument that the IS community should take the idea of experience seriously and systematically explore how digital technologies are transforming our everyday experiences. I believe this will open up a rich, new research avenue for the IS community.

In this paper, I purposely focused on the implications of digitalization in the context of everyday experiences in order to highlight the unexplored area of inquiry around which the IS community can mobilize its resources. However, this does not mean that many of the issues that I raised here and some of the research opportunities cannot be studied in an organizational context. In fact, many of the issues that I raised here can be explored in the context of work practices in an organizational setting. The preeminent importance of place, the transformation of meanings associated with artifacts, activities and place, and the importance of lived human experiences as a way of understanding the impact of radical digital convergence are all relevant research topics within the familiar boundary of the organizational use of IT.

As experiential computing deals with our everyday experiences, which is a fundamental aspect of our existence, the study of experiential computing will force us to face more fundamental questions. In

particular, I see the value of technology as one such issue. For a long time, a fundamental assumption of information technology has been that it is a tool. The value of information technology, therefore, has always been understood in the context of enabling other values, mostly economic, in IS literature. That is, technology has been understood through its *instrumental value*, what something is *for*. The emphasis of usability, usefulness, task-technology fit, productivity gain and user satisfaction in traditional IS research all reflect instrumental value. Experiential computing, however, adds a new value dimension. Some activities and experiences that we enjoy cannot be measured in an economic sense. Listening to Mozart, reading Tolstoy, enjoying Van Gogh, walking a dog and having a good conversation with friends over fine wine – these things do not necessarily have value for other things. Instead, they in themselves *are* valuable. These activities have *inherent value*, what something *is*. These activities and experiences with inherent values are the things that make us human and different from other species. As information technology is becoming more deeply embedded into human existence, perhaps the design of information technology needs to consider such inherent humanistic value.

The IS field was originally born as a discipline of artificial science. Over time, as the discipline has matured, the idea of the science of the artificial has faded and like many other disciplines, the IS field has become more like natural science as many of us are more concerned about discovery rather than design (Boland and Collopy 2004; Dahlbom 2002; Simon 1996). As the world is filled with more digitalized artifacts, however, the need for an artificial science is greater than ever. With recent interests in artifacts (Benbasat and Zmud 2003; Orlikowski and Iacono 2001), design (Hevner et al. 2004; March et al. 2000) and materiality (Leonardi and Barley 2008; Orlikowski and Scott 2008), the IS discipline is well situated to reclaim its intellectual roots as an artificial science by decisively expanding the scope of its inquiry. I hope this essay contributes to that return.

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