This article has been published in:
Bilandzic, M., & Venable, J. (2011). Towards Participatory Action Design Research: Adapting Action Research and Design Science Research Methods for Urban Informatics. Journal of Community Informatics. Special Issue: Research in Action: Linking Communities and Universities, 7(3).

Towards Participatory Action Design Research: Adapting Action Research and Design Science Research Methods for Urban Informatics

Mark Bilandzic
Urban Informatics Research Lab
Queensland University of Technology
mark.bilandzic@qut.edu.au

John Venable
School of Information Systems
Curtin University
j.venable@curtin.edu.au

Abstract

This paper proposes a new research method, Participatory Action Design Research (PADR), for studies in the Urban Informatics domain. PADR supports Urban Informatics research in developing new technological means (e.g. using mobile and ubiquitous computing) to resolve contemporary issues or support everyday life in urban environments. The paper discusses the nature, aims and inherent methodological needs of Urban Informatics research, and proposes PADR as a method to address these needs. Situated in a socio-technical context, Urban Informatics requires a close dialogue between social and design-oriented fields of research as well as their methods. PADR combines Action Research and Design Science Research, both of which are used in Information Systems, another field with a strong socio-technical emphasis, and further adapts them to the cross-disciplinary needs and research context of Urban Informatics.

Introduction: Urban Informatics – A Research Field at the Intersection of People, Place and Technology

The introduction of information and communication technology (ICT), particularly the more recent introduction of mobile and ubiquitous computing technology, continues to trigger profound changes in everyday life. ICTs have entered and become an established component of our cities, infrastructure and daily environments. They have blurred the borders between the physical and the digital and reshaped the way people interact and communicate with each other. People's interaction and communication patterns in everyday life constantly and seamlessly shift back and forth between physical and digital spaces. The domain of daily sociability and experience has become a 'hybrid space' (De Souza e Silva, 2006) – a space that

encompasses the infrastructure (Dourish & Bell, 2007), affordances (Norman, 1999) and other characteristics of both the physical as well as the digital.[1]

Urban Informatics is a research field that has emerged through the rising significance and need to investigate this ecology in the context of urban life and environments. It has been defined as "*the study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures*" (Foth, Choi, & Satchell, 2011). In order to study urban experiences and everyday urban life, it combines members of three broad academic communities: "the social (media studies, communications studies, cultural studies, etc.), the urban (urban studies, urban planning, etc.), and the technical (computer science, software design, human-computer interaction, etc.) …" (Foth, 2009, p.xxix). It engages in social, cultural and urban studies to understand the urban context, and works in close partnerships with city councils, communities, local organisations as well as public state and government institutions to adapt, develop and pilot innovative technologies and techniques from the fields of ubiquitous computing (ubicomp) and human-computer interaction (HCI) in real-world settings.

Urban Informatics is closely related to Community Informatics (CI), but goes beyond what is referred to as 'urban community informatics' (Gurstein, 2010), i.e. the application of CI goals to urban environments. Urban Informatics shares some common goals with CI, yet has a stronger focus on urban studies and addressing issues in the urban context through relevant innovations drawing on mobile technologies, ubicomp and HCI.

Whilst CI has a strong focus on empowering communities, i.e. "transfer responsibility and authority to communities and away from central institutions" (Gurstein, 2007, p. 79) and in doing so tends to look at communities as a whole, Urban Informatics regards communities more as a *network of individuals* (Wellman, 2002) and strives to enhance the connectedness between these networked individuals. It is not necessarily driven by the idea to enhance the notion or formation of a community as such, or to necessarily support shared community goals or ideals. Urban informatics is rather interested in how ubicomp artefacts can enhance the communicative ecologies (Hearn & Foth, 2005; Tacchi, Slater, & Hearn, 2003) of individuals in the context of their everyday urban life in general. Hereby, Urban Informatics research is actively involved in the design, development and evaluation of such artefacts.

The vision of ubicomp is to embed computing "into the fabrics of everyday live" (Weiser 1991), focusing on technologies and networked computing devices that become an integral part of people's daily communication and interaction habits as well as perceptions of the world (Schmidt, Langheinrich, & Kersting, 2011). Mobile phone communication, wireless internet, location-based mobile services, interactive public screens and electronic road pricing systems are examples of ubicomp scenarios and technologies that have become mundane – their infrastructure is not only being actively lived by people, but also affects their spatial behaviour (Forlano, 2009;

[1] In this context we look at the impact of recent ICT developments on urban life in developed countries. Though, as the mobile phone and other ubiquitous technologies enable developing countries to leapfrog into more advanced economies, similar impacts might be relevant for urban life in developing countries soon.

Gordon & de Souza e Silva, 2011; Willis, 2007) as well as practices in urban public spaces (Crawford, 2008; Humphreys, 2010).

Urban Informatics, as a core field of research in the intersection of urban studies and ubicomp, aims to understand and shape such communication and interaction patterns in the hybrid space as they evolve. It cannot wait until a new technology has become mundane, but needs to actively take action and learn through reflection by participating in early design, evaluation and re-design of new forms of ICT. This endeavour requires not only the capacity and methods to design, develop and deploy innovative technology, but more so a deep understanding of individual people's everyday life and inherent interplay with their social environments and urban infrastructure.

The success of both CI and Urban Informatics applications depend on whether they are accepted and adopted by people and effectively used in their social or community processes. Whilst CI has a strong focus on investigating the 'effective use' of ICT (Gurstein, 2003), i.e. the ability for a particular community to benefit from a particular ICT, it does usually not engage in addressing experienced issues through proactive development or redesign of new technologies. Research on technology acceptance provides strong empirical evidence that people's acceptance of technology primarily has two determinants – perceived usefulness and perceived ease-of-use (Davis, 1989; Venkatesh, Davis, & Morris, 2007; Venkatesh, Morris, Davis, & Davis, 2003). The nature of most CI studies implicitly covers the evaluation of perceived usefulness (and sometimes, but to a far lesser degree the usability of deployed ICT), however, it usually lacks HCI related aspects such as user-centred iterative design-development-evaluation cycles to feed experienced issues back and keep amending prototypes until they reach a stable design. This gap has been addressed by the special issue on "Community Informatics and System Design" in the Journal of Community Informatics (JoCI, 2007), in particular (Bourgeois & Horan, 2007; de Moor, 2007), but in practice the vast majority of submitted CI articles has no or only weak goals towards exploring opportunities through proactive design, development and evaluation of new ICT. HCI and ubicomp on the other hand have a strong focus on design, development and evaluation, but traditionally not used to study how technology interplays with people's everyday lived experience (*cf.* McCarthy & Wright, 2004).

We regard Urban Informatics as a field of research that interlinks and complements the foci from various disciplines, i.e. (1) urban sociology and its broad focus on urban everyday life and issues in the urban context, (2) CI and its focus on evaluating effective use of ICT in real-world settings, (3) ubicomp and its focus on engineering and development of new ICT and (4) HCI and its focus on interaction design and usability studies. The underlying belief of Urban Informatics is that only through such an inclusive and cross-disciplinary approach can innovative ICT opportunities be successfully identified, designed, developed and deployed towards organically adding value to people's lives and everyday tasks. This approach also aims to avoid techno-utopianism (Pitkin, 2001) and to detect potential negative socio-cultural consequences of new technology at an early stage.

The topic of this paper is concerned with how the cross-disciplinary requirements described above can be tackled methodologically. How can the individual disciplinary lenses through which Urban Informatics is investigated be combined towards a methodological framework that comprises and mutually nourishes findings towards

trans-disciplinary impacts? Hence, we formulate the underlying research question of this paper as following:

What would be the characteristics and structure of a good method for conducing Urban Informatics research?

In particular, Urban Informatics researchers often find promising opportunities in ubicomp technology when studying the urban context. The question is what happens when the analysis process identifies that a design intervention, based for example on a new technology has a potential to provoke the desired action and change? At this point researchers face challenges related to incorporating action and social change, with design and development-oriented process models and inherent goals. How can goals to improve a social setting be incorporated with engineering oriented goals towards design, development and evaluation of a new technology artefact?

The Scope of Cross-Disciplinary Research Activities in Urban Informatics

Urban Informatics as a discipline is primarily concerned with bridging the gap between needs and issues of people in the urban context, and opportunities provided by ICT. Urban Informatics involves both studying and understanding socio-cultural aspects of people, space and place and also solution-finding through planning, designing, building and evaluating innovative technology artefacts. Urban Informatics embodies a "transdisciplinary approach to understanding the city as an ecology that consists of technological, social, and architectural layers" (Foth, et al., 2011). Its research agenda covers topics, methods and issues raised across all three of those layers (figure 1).

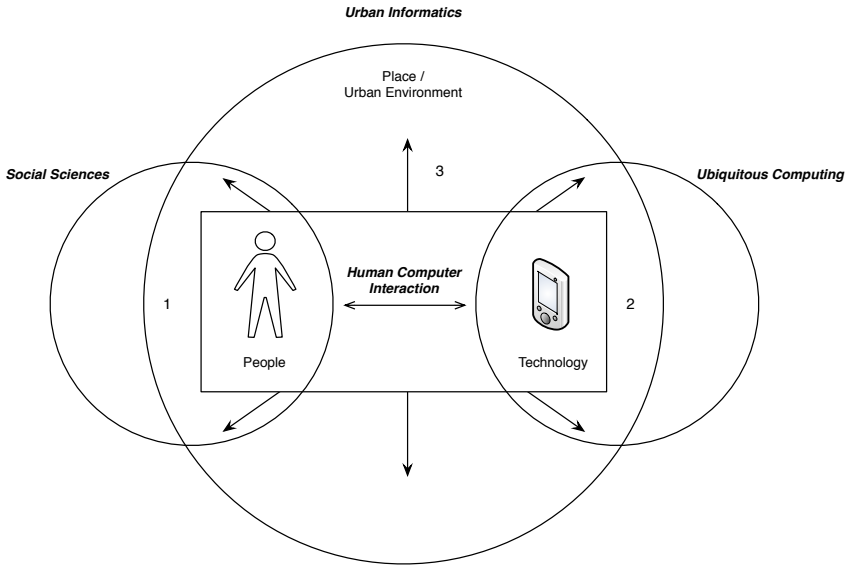

Figure 1: Urban Informatics covers topics, methods and issues across social, technology and design-oriented sciences applied in the urban context.

The underlying belief is that people networks, places and infrastructure cannot be studied merely as social and physical phenomena, but rather as an ecology of social, physical and technological domains. The *Discussions in Space* project at the Urban

Informatics Research Lab at Queensland University of Technology for example has spread across urban planning, HCI and communication design to explore opportunities of interactive public screens to engage local residents in urban planning related questions. Research outcomes address the urban planning (Schroeter & Houghton, 2011) as well as HCI community (Schroeter & Foth, 2009) creating interdisciplinary links and identifying opportunities for practitioners as well as researchers in both fields. Other Urban Informatics projects have studied different residential lifestyles to inform the role and design of ubicomp technology in inner-city apartments (Foth, Satchell, Bilandzic, Hearn, & Shelton, 2012), or have investigated ways to facilitate community networking in an Australian urban renewal site through location-based mobile phone services; hereby the study has again produced cross-disciplinary outcomes, i.e. for managers and researchers of urban renewal sites on the one hand (Klaebe, Adkins, Foth, & Hearn, 2009) and the mobile systems design community on the other hand (Bilandzic & Foth, 2009; Bilandzic, Foth, & De Luca, 2008).

These projects illustrate how Urban Informatics forms a nexus of social, urban and technological studies towards understanding urban life from a holistic point of view. This nexus builds strong ties between academia and public institutions or industry in order to design and evaluate digital technology artefact as organic parts of people's experiences in the context of urban life. Based on this understanding, we propose following tasks and activities to frame the cross-disciplinary spectrum of research efforts that an Urban Informatics project can have:

First, it engages in understanding and analysing a wide spectrum of contemporary issues and needs in the urban context, e.g. sustainable and healthy living, well-being, citizen engagement or social connectivity and experiences. Hereby, it embraces social, cultural and urban studies (e.g. Gordon & de Souza e Silva, 2011; Jacobs, 1961; Meyrowitz, 2005; Putnam, 1995; Watters, 2004; Wellman, 2002; W. H. Whyte, 1980), theories of space and place (e.g. Auge, 1995; Lefebvre, 1991; Massey, 1991; Oldenburg & Brissett, 1982; Relph, 1976; Soja, 1996; Tuan, 1977), critiques of everyday life (e.g. Certeau & Rendall, 1984; Lozanovska, 1989, 2002), place-making strategies (Project for Public Spaces, 2000; Schneekloth & Shibley, 1995; Walljasper, 2007) and relevant tools from these fields that help understand and address urban issues and phenomena from a social and cultural perspective.

In parallel, Urban Informatics studies keep track of opportunities provided by ubicomp technologies (Hornecker et al., 2006; Poslad, 2009) and focuses on ubicomp as a domain for potential solutions to the identified issues. Analysing the characteristics of the identified issues as well as capabilities and opportunities provided by ubicomp technology, an Urban Informatics study informs the role which ubicomp could and should have in the identified context. It proposes important contextual parameters to be facilitated or improved by an existing or future ubicomp artefact. At the same time, based on the elaborated analysis and understanding of the social and cultural context, it informs the design of the technology according to its role. Once the purpose and role have been defined, it embraces human-centred design and development methods (e.g. Ballagas, 2008; Foth & Axup, 2006; Hagen & Robertson, 2009) to shape a first prototype of an artefact.

Reflecting on the initial definition of its role and purpose, the artefact is iteratively evaluated in the real-world context against its effective use and impact on the social setting, and re-shaped until it reaches a stable design. Eventually, the outcomes are

reported to two different stakeholder groups; on the one hand, urban planners, architects, and managers who are concerned with design of urban public spaces in general, such as local governments or institutions in the urban context; For this audience, it is not of upmost importance which technology comes to use, or whether it is an innovative or existing design artefact, but rather if a particular social or organisational impact can be achieved by the artefact, and if yes, how? Technology is not considered for the sake of introducing technology, but to solve a targeted issue. It is seen as a means to tap opportunities (Hornecker, et al., 2006) that would not exist otherwise. On the other hand, Urban Informatics studies feed evaluation of real-world use results back to design and technology-oriented research fields such as ubicomp and HCI. These can then be incorporated into requirements for future work in those fields.

Methodological Challenges in Urban Informatics

With the cross-disciplinary orientation of research efforts embodied in the mission of Urban Informatics come some significant methodological challenges. In particular they raise questions situated in the intersection between the social and technology-oriented goals, i.e.

- How can outcomes from social, cultural and urban studies be interpreted and translated into implications for design of new technology?
- How can the social and cultural context of an urban site organically shape the design of an artefact as it is being developed?
- How can a new artefact be evaluated in a way that the outcomes feed new questions back to social as well as technology oriented members of the research community?

Engineering as a field focusing on design and technology-driven studies, has powerful tools to build useful technology artefacts and continuous technological improvements to these artefacts, but generally lacks the potential to deal with "messy human situations" (Baskerville, Pries-Heje, & Venable, 2007). It has little or no tradition in understanding the social context, which is necessary to shape an artefact's design from a socio-technical perspective. Shaping technology so they fit into messy human situation is "highly relevant to the success or failure of IT artefacts" (Baskerville, et al., 2007, p.17).

Dealing effectively with complex, messy human situations is especially critical when ICT becomes a significant part of everyday life and infrastructure, such as through mobile and ubicomp technology. In this context, Bell and Dourish propose that "…perhaps dealing with the messiness of everyday life should be a central element of ubicomp's research agenda" (Bell & Dourish, 2007, p.134). Coyne notes "the move to the everyday promotes methods of research that engage with narrative and socially situated ethnographic study, rather than the transportation of phenomena to the laboratory, or isolation into the calculative world of variables and quantities" (Coyne, 2010, p. 74).

Based on such thoughts, we consider the very transition from understanding the dynamics of a social-cultural environment towards informing the design and organically embedding a technology artefact in this socio-cultural environment as crucial for the success of an Urban Informatics project. However, using isolated tools from either engineering or social sciences does not meet the methodological

requirements to achieve these goals. The question is, what would be effective mechanisms to incorporate and cross-fertilise insights from the social as well as technological perspective?

Ethnography provides explicit tools to help understand the facets of a socio-cultural setting in a detailed and fine-grained manner. However, having its roots in social sciences, traditional ethnographic research does not necessarily imply or propose specific implications for the design of an artefact (Hughes, King, Rodden, & Andersen, 1995). Furthermore, an ethnographic study in its traditional form can sometimes take years, a "prolonged activity" (Hughes, et al., 1995, p.59) largely unsuitable to informing system design. A compromise established to bridge the dichotomy between understanding social aspects of a setting and technology design goals are methods that follow a "quick and dirty" principle of ethnographic research.

However, such ethnographic techniques – mainly applied to inform the design of a specific artefact – might 'marginalise' theory (Dourish, 2006) and miss important social contexts and human factors of the targeted environment that are crucial to understand what role design and technology can or should have at the targeted site in the first place. From this point of view, 'quick and dirty' ethnographic studies explicitly aimed at finding implications on design seem to be methodologically paradoxical in some sense. The role and significance of ethnography in the context of ubicomp and HCI has caused some earlier confusion. Dourish (2007) reminds us that ethnography might not outline obvious implications for design, but should rather be recognised through its core strength, i.e. understanding, describing and capturing social and cultural phenomena, which inherently might embody aspects relevant to designers.

In Urban Informatics, we recognise the importance of ethnographic research, yet we are specifically interested in how it informs the role and design of future technology. Thus, in its constant efforts to investigate 'implications on design', Urban Informatics continuously seeks for methodological approaches that provide an informed trade-off between traditional ethnographic studies, that are often too lengthy and time-consuming for the sake of 'just' informing design, and 'quick and dirty' methods that might 'marginalize theory' hence miss important social or cultural aspects of the underlying site. From a methodological point of view, an umbrella framework that addresses these needs requires tools from soft as well as hard science disciplines.

Situated in a similar dichotomy between design-oriented thinking and investigation of relevant social aspects in organisational settings, research in Information Systems (IS) has faced similar methodological challenges as Urban Informatics. IS research targets information technology that is implemented to improve effectiveness and efficiency in organisational settings (Silver, Markus, & Beath, 1995). The IS research field is concerned with technical as well as social issues related to the effective use of information technology in the organisational context. Based on this interdisciplinary setting, IS research embraces various ontological and epistemological traditions, as well as applied methodologies.

Review studies of established IS journals show two predominant research approaches in IS research (Schauer & Frank, 2007; Wilde & Hess, 2007). On the one hand, there is more design-oriented IS research (predominantly focused on by for example, the German 'Wirtschaftsinformatik'), and on the other hand, studies that are more aligned towards behavioural sciences and theory building or testing (e.g. particularly in the American field of IS Research). Implicitly, the practical as well as theoretical

contributions of different IS studies are often polarised, i.e. either focused on design and technical innovation of new IS artefacts (Hevner, March, Park, & Ram, 2004; March & Smith, 1995), or oriented towards IT-related, but social, cultural and behavioural organisation specific issues.

Realising the importance of a dialogue between both ends of the IS-Research spectrum, IS methodology literature has extensively discussed Action Research (AR) and Design Science Research (DSR) as two methodological frameworks that address design-oriented issues from a technical, as well as socio-cultural perspective (Baskerville, et al., 2007; Cole, Purao, Rossi, & Sein, 2005; Figueiredo & Cunha, 2006; Iivari & Venable, 2009; Jarvinen, 2007). In the following section we discuss the relevant outcomes of this discussion and how Urban Informatics, as a comparatively young field of research that faces similar methodological challenges, can learn and benefit from it.

Action Research and Design Science Research in IS

Action Research (AR) is research which investigates a phenomenon through intervention in a problematic situation. It is distinguished by simultaneously working to achieve two goals, that of making an improvement in the problematic situation while at the same time researching the phenomenon or phenomena of interest. Typically a researcher who acts as an expert works together with laypeople (the clients) who have an interest in resolving or improving the problematic situation. The researcher and the clients decide upon a course of action (typically recommended by the researcher), carry out the course of action, and the researcher studies what happens during and after the intervention. Both the client(s) and the researcher benefit from the collaboration. The act of intervening allows the researcher to study complex organisational phenomena that occur before, during, and after the intervention and usually to study and characterise the benefits and difficulties of the intervention itself. Indeed, the research may (but also may not) involve development and/or application of new techniques and technologies that are the main topic of the research (Iivari & Venable, 2009).

Action Research has had a long history, both within and outside of the field of Information Systems. While at its heart, the idea of collaborative investigation by researcher and client is a simple one that has probably been conducted as long as people have been engaged in 'research', AR has its modern roots in work conducted at the Tavistock Institute, as exemplified by that reported by Kurt Lewin (Lewin, 1951). Another seminal work on AR is that of Susman and Evered (Susman & Evered, 1978), who laid out its key principles. As the field of IS became more interested in the social issues of technology intervention in organisations (e.g. the application of power and its consequences during IS development), AR was a natural approach to adopt. AR has been used heavily in researching and developing systems methodologies. For example, Checkland and others used AR as the main approach for the development and refinement of Soft Systems Methodology (Checkland, 1981; Checkland & Scholes, 1990). The rise of the use of AR within the field of IS has coincided with a general broadening of the IS field to accept (if not embrace) a plurality of both positivist and interpretive research methods and paradigms. A watershed event in this broadening was the 1984 IFIP Working Group 8.2 working conference held in Manchester in the UK (Mumford, Hirschheim, Fitzgerald, & Wood-Harper, 1985).

There are many versions of Action Research, both within and outside of the field of IS (Baskerville, 1999). Within the IS field, the work of Susman and Evered (Susman & Evered, 1978) continues to be heavily cited, but today the approach of Canonical Action Research (Davidson, Martinsons, & Kock, 2004) is the most commonly cited and applied. Participatory Action Research (PAR) (Argyris & Schön, 1989; Wadsworth, 1998; W. F. Whyte, Greenwood, & Lazes, 1989), which was developed in the field of Organisational Behaviour (OB) has also been used in IS. PAR is Action Research that "involves practitioners as both subjects and co-researchers (Argyris & Schön, 1989, p. 613). The involvement is extensive rather than just consultative, with active participation "throughout the research process from the initial design to the final presentation of results and discussion of their action implications" (W. F. Whyte, et al., 1989, p. 514). Participatory Design (PD) or its earlier version Cooperative Design (Kensing, 2003; Schuler & Namioka, 1993) address similar issues, but can be considered to be related to information system development in practice rather than in research per se. Closely related to PAR and closely related to each other are Community Based Research (CBR) (Israel, Schulz, Parker, & Becker, 1998) and Community Based Participatory Research (CBPR) (Minkler & Wallerstein, 2003; Wallerstein & Duran, 2010), which both arise in the field of Public Health. CBR and CBPR extend PAR by involving members of a community with the goals of improving the research rigor and relevance, but also addressing power imbalances and empowering the community (Israel, et al., 1998; Wallerstein & Duran, 2010).

Ethnographic Action Research (EAR) was developed for use in research on community-based ICT for development in the field of media and communication studies (Tacchi, Foth, & Hearn, 2009; Tacchi, et al., 2003). In comparison with PAR, EAR extends the engagement with the participants or client community by studying its needs using ethnographic methods, such as observation, participant observation, in-depth interviews, and feedback mechanisms. In comparison to more traditional ethnographic methods, EAR facilitates practical application through activities of planning and action based on what is learned through the ethnography. Network Action Research (NAR) (Foth, 2006) can be considered a form of CBR or PAR in which the intent is to increase the enfranchisement and participation of a community by seeking to understand and involve its different social networks and sub-networks and helping the community to develop not just one but a set of AR projects in which the members of the different networks become actively involved and lead for themselves. This variety of different AR approaches offers many possibilities for developing a research approach to support Urban Informatics.

In general, the various approaches to AR described above differ largely in the manner and extent to which the practitioner/participant community is engaged, its needs understood, and its empowerment to decide how the research will be conducted and it what ways it will benefit.

Setting aside the issues of the manner and extent of participation by the clients (or co-researchers) for the moment, the AR process is largely the same. Baskerville (1999) describes the action and change orientation of the Action Research approach in a simple two stage process: the diagnostic stage and the therapeutic stage. This simple process is more commonly expanded with three iterative activities relating to the therapeutic stage and a final stage specifying the learning (which is related to both the action to improve and the research outcomes), resulting in five stages as shown in figure 2 (Lewin, 1951; Susman & Evered, 1978). In the diagnostic stage (stage 1), the researcher and the group of problem owners collaboratively analyse a social (or socio-

technical) setting, and hypotheses are formulated about the nature of the research domain. The therapeutic stage includes iterative steps of action planning (stage 2), action taking (stage 3), and evaluating (stage 4). Learning (stage 5) is concerned with reflection and capturing lessons both for the benefit of the participants and to be reported as the outcomes of the research (Lewin, 1951; Susman & Evered, 1978).

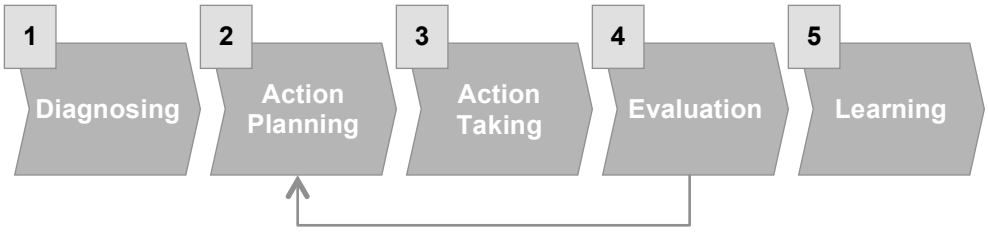

Figure 2: The Action Research Process Model

As described above, there is a long history in the Information Systems field of the use of Action Research. Somewhat more recently, the Design Science Research paradigm has received significant renewed attention, culminating in the 2004 MIS Quarterly paper by Hevner et al (2004) and the DESRIST (Design Science Research in Information Systems and Technology) international conferences (2006-2011). The renewed interest in DSR stems from a frustration by some in the IS field with its increasing focus on gaining an empirical understanding of the current situation and its (seeming) lack of respect for research that creates new technologies to solve existing problems.

The discussion of DSR in the IS field has covered a broad methodological and theoretical ground, including fitting DSR activities into a broader set of research activities, development of formulations of IS Design Theory (Gregor & Jones, 2007; Venable, 2006b; Walls, Widmeyer, & El Sawy, 1992) and methodologies for conducting DSR (e.g., Peffers, Tuunanen, Rothenberger, & Chatterjee, 2008).

In relating DSR to other forms of research, Venable (2006b) developed a framework of four activities: problem diagnosis, solution technology invention, evaluation, and theory building. He noted that the solution technology invention is the key activity that distinguishes DSR. The activities of problem diagnosis and technology evaluation are conducted in other (empirical) research paradigms, whether positivist or interpretive.

An important aspect of DSR is that it seeks to solve general problems, not just specific, situated (one-of-a-kind) problems, so that the knowledge produced about the solution developed can be adapted and applied (in practice) to other specific, situated problems (instances of the general problem) (Venable, 2006a).

A number of papers have set out processes for conducting DSR, including Nunamaker et al (1991), Vaishnavi and Kuechler (2004), Venable (2006a), and Peffers et al (2008). Figure 3 below distils out the key activities.

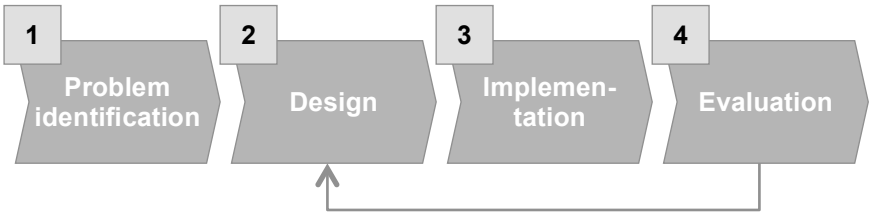

Figure 3: The Design Science Research Process Model

While the above papers concern DSR in the information systems field, the same ideas can be applied to Urban Informatics. In order to make improvements (in this case to the urban environment and people's experiences of and in it), problems must be investigated and diagnosed (using empirical methods and paradigms) to inform design of novel solution technologies (e.g. applications using mobile and ubicomp) using the DSR paradigm. Following the development of new technologies, they should be evaluated to provide evidence that the new technology has utility with respect to solving the relevant problem or making a desired improvement. It is proper evaluation that justifies the use of the word "Science" within DSR.

In the DSR methodology area, somewhat more recently, there has been extensive discussion of the differences and similarities between AR and DSR (Iivari & Venable, 2009; Jarvinen, 2007), their respective roles (Iivari & Venable, 2009), and why and how they could be fruitfully integrated (Baskerville, et al., 2007; Baskerville, Pries-Heje, & Venable, 2009; Cole, et al., 2005; Sein, Henfridsson, Purao, Rossi, & Lindgren, 2011). Such an approach ensures a more relevant grounding of a DSR effort in realistic understanding of relevant organisational problems and supports naturalistic evaluation (Venable, 2006a) of the designed new technology.

Baskerville et al (2009) take inspiration from Soft Systems Methodology (Checkland, 1981; Checkland & Scholes, 1990) to develop a method they call Soft Design Science Methodology. The method includes explicit steps for identifying a problem, generalising the problem, developing a generalised solution, checking that the generalised solution relates back appropriately to the original problem, and implementing and evaluating the solution.

Sein et al (2011) explicate their Action Design Research methodology. A key tenet of the method is that new information systems are or should not be developed in isolation from the environment(s) in which they would be used in a top down fashion and are not designed and implemented fully formed, ready to go. Indeed, designs for new technologies instead *emerge* from the interaction of designers and users and the authentic evaluation of the new technology (*cf*. "naturalistic evaluation" in Venable (2006a)). They propose that there should be tight coupling between the research activities of building, intervention, and evaluation (BIE) in a cycle, with extensive participation by key stakeholders (researchers, problem owners, and system users).

From this perspective, one could assert that it may be fruitful to borrow Soft DSR or Action Design Research wholesale for use in Urban Informatics research (figure 4). However, it is fruitful to more critically consider how IS and Urban Informatics are similar and different before doing so. In fact, there are significant differences between the two research fields, which will warrant adapting rather than adopting IS research methods combining AR and DSR.

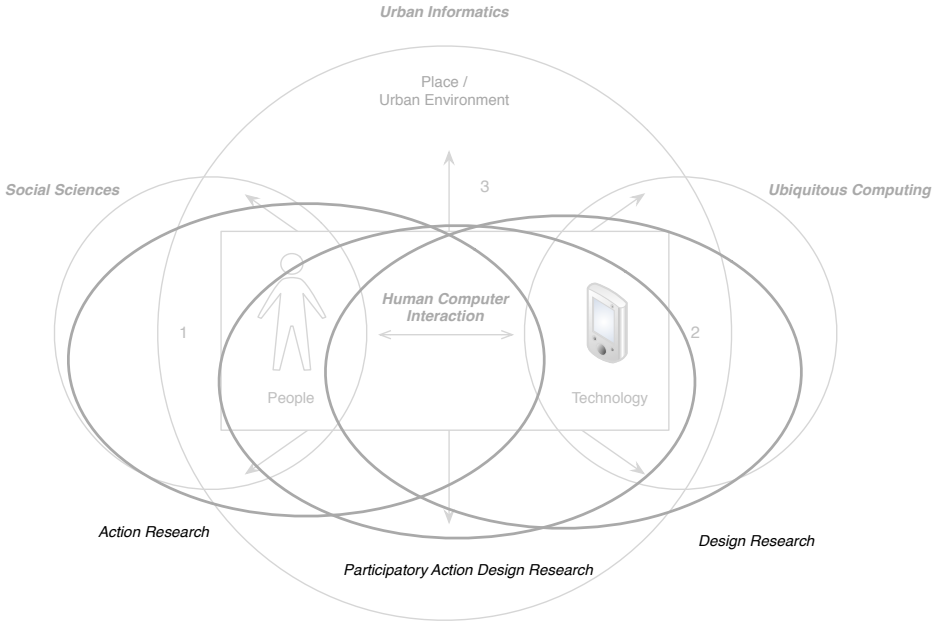

Figure 4: Participatory Action Design Research incorporates technological innovation with methods to shape design according to the socio-cultural context.

Participatory Action Design Research: Adapting Action Design Research for Urban Informatics

Table 1 below contrasts the IS and Urban Informatics research disciplines. The information systems discipline focuses largely on improving organisations, largely businesses, and therefore largely on goals relating directly or indirectly to profit. Urban Informatics on the other hand focuses largely on the community or societal level, and therefore mostly on social good as a goal. Perhaps more importantly for our purposes here, the decision makers for information systems are largely managers, who mostly agree about the goal of profit, and therefore largely can reach agreement on the goal(s) and the solution(s) to pursue, as well as the kind of improvement desired and how one can determine whether it is achieved or not. In Urban Informatics on the other hand, there may be a multiplicity of clients and other stakeholders, e.g. city planners, government, developers and local organisations, not to mention the public. It is important to build effective partnerships (Foth & Adkins, 2006) between these communities and to get a mutual understanding of their individual goals and motivations when conceptualising solutions to shared problems.

Another significant difference is the relatively closed nature of the environment of IS versus the quite open nature of Urban Informatics. This includes aspects such as the technological environment, the users, and the context of usage itself. Urban Informatics largely targets members of the public as end users. Their backgrounds, motivations and needs can be very heterogeneous and relatively hard to predict compared to the ones of employees in an organisational setting. Similarly, the technological environment in Urban Informatics is almost completely open – anyone can use or not use (Satchell & Dourish, 2009) whatever application they want within a given public space. Furthermore, any member of the public can typically select the space where s/he uses (or doesn't use) an application. The user context in Urban Informatics is open, mobile and widely varying from situation to situation in people's everyday lives, whereas in business organisations, the environment is typically more

closed, fixed (although wireless access changes this) and predictable. Finally, a key difference is that the role of place, space, and location is essential to Urban Informatics as they significantly affect the user's situated context and experience (Lentini & Decortis, 2010) whereas it is of low relevance, largely incidental within the IS field (although its role is increasing for some application areas).

Characteristic	Information Systems	Urban Informatics
Level	Organisational	Community, Urban dwellers
Dominant Goal	Profit	Social good
Sub-goals (e.g.)	Efficiency, Effectiveness	Well-being, health, social connectedness
Decision maker	Management/employer	Government / public institution
Environment / User context	Closed, fixed, predictable	Open, mobile, diverse
User access	Private, limited access	Public, access for all
Users	Employees	Public
Usage	Largely mandatory	Completely discretionary
Location and Place	Low relevance	Essential

Table 1: Contrasts between Information Systems and Urban Informatics Research

The implications of these differences are important when considering an appropriation of IS methodologies for Urban Informatics. A combined AR and DSR approach needs to consider these issues carefully, be able to cope well and clearly with them, and be adaptable where possible. To sum up, Soft DSR (Baskerville, et al., 2007, 2009) or ADR (Sein, et al., 2011) from the IS domain, would need to be adapted to the context of Urban Informatics, not simply adopted wholesale. Indeed, rather than adapting Soft DSR or ADR, it might be more fruitful to pick and choose different aspects of the AR and DSR approaches described above to fit the unique requirements of research in Urban Informatics. We do so and propose a new method called Participatory Action Design Research (PADR) below.

Figure 5 below gives an overview of the PADR method we have developed, which combines variations of AR and DSR approaches to meet the needs of Urban Informatics. The reminder of the section will explain how this adaptation might be achieved, according to the usual context and stakeholders of an Urban Informatics project.

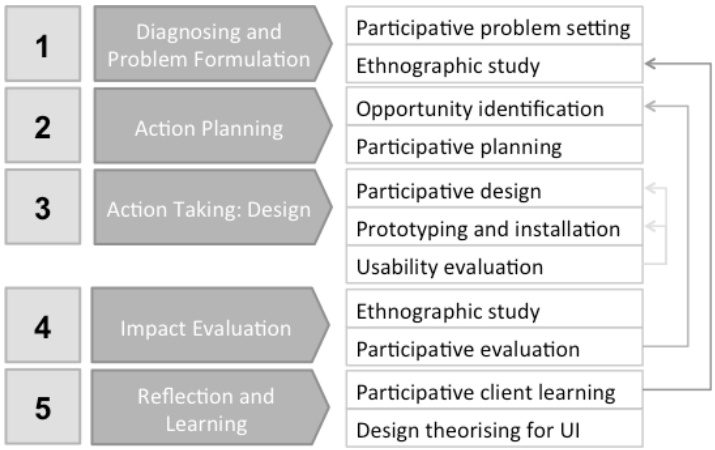

Figure 5: Participatory Action Design Research – a research method for Urban Informatics

As can be seen in figure 5, PADR has five phases or activities: diagnosing, action planning, action taking design intervention(s), impact evaluation, and learning and creation of actionable knowledge for the client. These five phases/activities are explained below.

(1) Diagnosing and Problem Formulation: For problem diagnosis, approaches are needed to identify stakeholders, analyse problems and develop shared understandings and agreement about "the" problem(s) to be solved. However, the phenomena to be researched in an Urban Informatics setting are not objective, but rather are socially constructed. The problem needs to be understood as variously experienced by a diversity of members of the public. Hence, usually not only the ones who the research is for (i.e. clients), but also the ones who would be affected by and who would be users of the technologies to be developed (i.e. the wider urban community and members of the public) need to be embraced as stakeholders and research partners in the Urban Informatics context. They need to be given a voice and treated as research collaborators rather than subjects when it comes to identifying issues in their everyday urban lives and finding solutions to these issues. Thus, an approach for participative problem setting (or problem formulation) is needed as shown for phase 1 in figure 5. We therefore propose that suitable techniques be borrowed from other Action Research approaches (see earlier descriptions above) such as Participatory Design (Kensing, 2003; Schuler & Namioka, 1993), Community Based Research (Israel, et al., 1998) or Community Based Participatory Research (Minkler & Wallerstein, 2003; Wallerstein & Duran, 2010), Network Action Research (Foth, 2006) or Participatory Action Research (Argyris & Schön, 1989; Wadsworth, 1998) to better engage stakeholders as clients and co-researchers.

Where the problem domain is complex and not already well understood (which is generally the case in Urban Informatics), ethnographic methods (as shown for phase 1 in figure 1 above) need to be used to gain a sufficiently rich understanding of the communicative ecologies in a particular site, and can be appropriated with Action Research goals. As described in the section of Action Research further above, colleagues from social as well as technology-oriented fields have recognised the need for a more integrated approach that bridges the gap between ethnography and action taking or design. As noted above, Tacchi et al. (2009) developed and tested a tailored

AR variation, Ethnographic Action Research (EAR), combining Action Research principles with ethnographic inquiry. The primary goal of EAR is to gather a rich understanding of a social setting, in particular identify problem areas and their roots. The goal in the PADR context is to understand the underlying problems in their social setting, and thus also inform the design and requirements of technological solutions. This is the basic goal of what Taylor refers to as design-oriented ethnography (Taylor, 2009). Such approaches are largely (but not completely) ignored in the IS field, especially in DSR.

Importantly, in Urban Informatics the context is one that rapidly changes, particularly as new technologies and social media applications are adopted and gain momentum on a monthly and sometimes even weekly basis. In their recent book Gordon and De Souza e Silva describe how "location and location-based media are evolving so rapidly that we are sure that between now and when this book is actually published, we will be looking at a different world" (Gordon & de Souza e Silva, 2011, p. ix). With the rapid developments and uptake of such technology, people constantly appropriate and change their everyday practices and patterns of sociability, interaction and communication. To accommodate this, one cannot simply use ethnographic methods wholesale as traditionally used because they would take too long. Therefore, a shorter, simpler approach needs to be taken, e.g. as described in Tacchi et al (Tacchi, et al., 2009; Tacchi, et al., 2003), which typically take a month or less.

Furthermore, problem analysis and formulation techniques can be borrowed from Soft System Methodology (Checkland 1981, Checkland and Scholes 1990), Soft Design Science (Baskerville, et al., 2009), or other problem solving methods. Techniques such as rich pictures from SSM, cognitive maps (Eden 1988, Eden and Ackerman 2001, Ackerman and Eden 2001), or a variation called coloured cognitive maps (Venable, 2005) may be more helpful in eliciting and sharing problem understandings. Definitions of utility and what is to be evaluated in the application of and intervention with the artefact arise out of the formulation and definition of the problem(s) to be solved. These approaches also provide techniques to facilitate and obtain agreement about the problem(s) to be solved.

Summing up, the Urban Informatics researcher together with the clients and other stakeholders needs to make use of ways to organise and facilitate participation, ethnographic means to investigate the diversity of needs from the variety of stakeholders in the community/public to be served (or just affected), as well as techniques for analysing, formulating, and socially constructing the problem(s) and obtaining agreement about it/them.

(2) Action Planning: As described further above, Urban Informatics often faces the situation where action requires a design intervention, e.g. creating a mobile phone application or ubicomp artefact. Design, development and evaluation of such artefacts usually follow the traditional DSR process (Hevner, et al., 2004; Iivari, 2007), i.e. problem identification/requirements analysis, design, implementation, and evaluation. As shown in figure 1 phase 2, action planning for using DSR begins with opportunity identification (*cf.* 'suggestion' activity in Vaishnavi and Kuechler (2004) and the early part of 'theory building' in Venable (2006a, 2006b)), in which an idea for a suitable new technology to address the issues at hand is identified for development.

Another problem at this phase is how to translate the findings from diagnosing (phase 1) to design implications for the artefact to be developed. How can the findings be captured and communicated to all stakeholders as a basis to collaboratively work

towards a shared solution? Design personas, a common tool in interaction design might be useful here, in particular to create "composite user archetypes" (*cf.* Cooper, Reimann, & Cronin, 2007, p. 82) with the main motivations and needs of members from the wider community.

Further, since a fully participative approach is being taken, it is important that the participants are involved as co-planners (i.e. participative planning as shown in figure 1) for the action taking, i.e. the design, development, testing, and implementation and evaluation of the new technology. This should lead to increased participation, better fit of the design to the diverse requirements, and more complete and realistic evaluation in the action taking and impact evaluation phases (phases 3 and 4).

(3) Action Taking: As essentially a DSR project at this point, this phase is concerned primarily with design and development of the technology, as well as preliminary testing (particularly including usability testing of prototypes of the designed system). As shown in figure 1, this phase involves participative design, prototyping, and usability evaluation. Participative design has been discussed earlier in this paper and in the literature (Kensing, 2003; Schuler & Namioka, 1993). In terms of prototyping, ADR (Sein et al 2011) recommends the use of various prototypes – alpha and beta prototypes – in regular and "authentic" evaluation as part of the BIE (building, intervening, evaluating) activity (i.e. phases 3 and 4). How one can evaluate an artefact with a prototype in such an open environment, without unnecessarily disrupting people's lives and without a full implementation needs to be carefully considered. Here the recommendations in Baskerville et al (2011), who identify evaluation goals and how to achieve them using a combination of ex ante and ex post evaluations, may be helpful. How to keep the clients and end users actively involved in the cycles of this activity also will require care (which should also be considered during the Action Planning phase). Experience Prototyping (Buchenau & Suri, 2000) provides opportunities to gather an understanding of existing and future conditions through actively engaging end users with early prototypes and communicating ideas between designers, clients and end users at an early stage. At an absolute minimum, a usability evaluation is important before releasing a system to the public at large. Indeed, as shown in figure 1, iterating back to the participative design and prototyping activities during Action Taking may be warranted, both due to usability issues or other issues discovered using other ex ante evaluation approaches.

(4) Impact evaluation: In respect to the overall goal in Urban Informatics, the first step (diagnosing) and last two steps (evaluation and learning) are pre-set by the AR framework. In step 1, researchers, clients and stakeholders collaboratively define an issue or point of focus and any actions or design interventions taken are evaluated according to how they have contributed to the initial setting. As shown in figure 1, impact evaluation should also be conducted participatively, following a CBR, CBPR, or PAR approach. Furthermore, since the impacts may be subtle and varied across the different stakeholders and the use of the technology in its socio-technical context may create a whole new ecology, ethnographic methods may again be very useful and we suggest their use at this phase. Longer term evaluation may be useful, but again a quicker form of ethnographic study may be appropriate as in EAR. Furthermore, embedding design and usability evaluation methods from HCI will also provide valuable insights to the HCI community about new artefacts and interaction methods being used in real world, rather than in artificial laboratory settings (Ballagas, 2008; Brush, 2009; Hagen, Robertson, Kan, & Sadler, 2005).

Where the impact evaluation is found to be wanting, i.e. where the original design goals are not met or important new problems arise from the technological introduction, a decision may be made (by mutual agreement) to iterate back to an earlier phase of the research (as shown by the middle arrow in figure 1) and to replan the research and then to redesign and re-implement the system to better meet those needs based on what shortcomings have become apparent. This decision will of course be impacted by many factors including resources and the interest of the participants.

(5) Reflection and Learning: At some point in the study, the development has ended (for the time being) and the evaluation has reached a conclusion of sorts (although longer term, longitudinal evaluation may be ongoing). At that point it is essential that all the participants take time to reflect on what has happened and determine what has been learned. This is in line with all forms of Action Research and PADR is no exception. Guiding the participant client(s) and stakeholder(s) through a careful and explicit process of reflection and learning will ensure that the learning is authentic and realistic. Collaborative reflection and learning will also enable client(s) and stakeholder(s) to carry that knowledge forward for the benefit of themselves and the rest of the involved community – in the ongoing adoption and use of the developed technology as well as for the next round of development, adoption, and/or use of future technologies by the community and its members. The feedback of client and stakeholder (and researcher for that matter) learning to the next round of development and adoption is shown by the outer arrow in figure 1 above.

Furthermore, it is important that the learning be communicated to those not involved in the PADR research project. In the field of IS, DSR strongly suggests that the knowledge learned about the designed artefact and its utility in the context of the community and its situation be specified in the form of a Design Theory (Gregor & Jones, 2007; Venable, 2006b; Walls, et al., 1992), in this case as a UIDT (Urban Informatics Design Theory) rather than an ISDT (Information Systems Design Theory)!

Conclusion

Early in this paper we posed the following research question.

What would be the characteristics and structure of a good method for conducting Urban Informatics research?

In answer to this question, we have developed and proposed a new research method for Urban Informatics – Participatory Action Design Research (PADR). PADR supports Urban Informatics research to develop new technological means to resolve contemporary issues or support and improve everyday life in urban environments, e.g. using mobile and ubiquitous computing.

We described Urban Informatics as a research field that studies the convergence of the physical and the digital towards hybrid space infrastructures, emerging technologies and their impact on this hybrid space in the context of urban public places. We drew requirements for a methodological framework that meets the cross-disciplinary needs of the Urban Informatics research landscape, in particular studying socio-cultural urban life and context as well as opportunities to develop new technologies to improve them. Such research has to recognise the urban hybrid space

as an ecology of people, place and technology, rather than viewing them as separate entities in their disciplinary research silos. We highlighted methodological challenges in combining these domains, in particular in respect to bridging the gaps between ethnography (understanding the community-based socio-technical problem space), participative involvement and empowerment of the community of concern, action taking (solving the problem) and design-orientation (creating innovative design artefacts).

We identified IS as a research discipline that is situated in a similar dichotomy between design-oriented thinking and investigation of relevant social aspects, which hence faces somewhat similar methodological challenges to Urban Informatics. We broadly discussed literature and recent developments in IS methodology aimed at tackling these challenges, in particular the convergence of Action Research and Design Science Research (Baskerville, et al., 2007; Cole, et al., 2005; Figueiredo & Cunha, 2006; Iivari & Venable, 2009; Jarvinen, 2007). We further discussed various forms of Action Research that draw in participative and ethnographic approaches. However, drawing on differences between IS and Urban Informatics research disciplines we highlighted the need for AR and DSR approaches to be adapted rather than adopted for Urban Informatics and suggested various aspects to be considered.

In particular, we suggested drawing techniques from different variations of AR, such as EAR, PAR or Network AR, and including principles of PD or CBPR according to the particular setting of the research project. Design-oriented ethnography and design personas might serve as tools to bridge the gulf between outcomes from social, cultural and urban studies and implications for design of new technology. As artefacts are not only technologically, but more so socially constructed, they have to evolve, grow and be shaped by and within the organisational context (Iivari, 2003), rather than introduced overnight.

With these suggestions for adapting AR, its variants, and DSR, we propose an outline of a new method – Participatory Action Design Research (PADR) – to suit the needs of Urban Informatics and its usual research context and stakeholders. We believe that PADR has the potential to bring the design of ubicomp in the urban context closer to what has been earlier discussed as 'social construction' (Bijker, Hughes, & Pinch, 1987) or an 'ensemble view of technology' (Orlikowski & Iacono, 2001, p.26). In doing so it will also enable closer collaboration between academic researchers and the communities that they serve and benefit.

While we have carefully reasoned about the requirements and design of PADR, thus far, the new methodology has not been tried out in practice. A next stage in its development would be to do so.

Acknowledgements:

The authors would like to thank Marcus Foth, Greg Hearn, Richard Medland and the anonymous reviewers for their valuable comments on earlier versions of this paper.

References

Argyris, C., & Schön, D. A. (1989). Participatory action research and action science compared: A commentary. *American Behavioral Scientist, 32*(5), 612-623.

Auge, M. (1995). *Non-places: introduction to an anthropology of supermodernity*. London New York: Verso.

Ballagas, R. (2008). *Bringing Iterative Design to Ubiquitous Computing: Interaction Techniques, Toolkits, and Evaluation Methods*. Göttingen: Cuvillier.

Baskerville, R. (1999). Investigating information systems with action research. *Communications of AIS, 2*(3), 2-31.

Baskerville, R., Pries-Heje, J., & Venable, J. (2007). *Soft Design Science Research: Extending the Boundaries of Evaluation in Design Science Research*. Paper presented at the 2nd International Conference on Design Science Research in Information Systems and Technology (DESRIST 2007).

Baskerville, R., Pries-Heje, J., & Venable, J. (2009). Soft design science methodology. *Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology (DESRIST 2009), Philadelphia, Pennsylvania, USA, 7-8 May 2009*.

Baskerville, R., Pries-Heje, J., & Venable, J. (2011). A Risk Management Framework for Design Science Research. *Proceedings of the 44th Hawaii International Conference on System Science (HICSS 2011), Kauai, Hawaii, USA, 4-7 January 2011*, 1-10.

Bijker, W., Hughes, T., & Pinch, T. (Eds.). (1987). *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, Massachusetts: MIT Press.

Bilandzic, M., & Foth, M. (2009). Social Navigation and Local Folksonomies: Technical and Design Considerations for a Mobile Information System. *Handbook of Research on Social Software and Developing Community Ontologies*, 52-66.

Bilandzic, M., Foth, M., & De Luca, A. (2008). CityFlocks: Designing Social Navigation for Urban Mobile Information Systems. In G. Marsden, I. Ladeira & P. Kotzé (Eds.), *Proceedings ACM SIGCHI Designing Interactive Systems (DIS)* (pp. 174-183). Cape Town, South Africa.

Bourgeois, D. T., & Horan, T. A. (2007). A Design Theory Approach to Community Informatics: Community-centered Development and Action Research Testing of Online Social Networking Prototype. *The Journal of Community Informatics, 3*(1).

Brush, A. J. B. (2009). Ubiquitous Computing Field Studies. In J. Krumm (Ed.), *Ubiquitous Computing Fundamentals* (pp. 161-202): Chapman & Hall / CRC.

Buchenau, M., & Suri, J. F. (2000). *Experience prototyping.* Paper presented at the DIS 2000, Brooklyn, New York.

Certeau, M. d., & Rendall, S. (1984). *The practice of everyday life*. Berkeley: University of California Press.

Checkland, P. (1981). *Systems Thinking, Systems Practice*. Chichester, UK: Wiley.

Checkland, P., & Scholes, J. (1990). *Soft Systems Methodology in Action*. Chichester: J. Wiley.

Cole, R., Purao, S., Rossi, M., & Sein, M. (2005). *Being proactive: where action research meets design research*.

Cooper, A., Reimann, R., & Cronin, D. (2007). *About face 3 : the essentials of interaction design* (3rd. ed.). Indianapolis, IN: Wiley Pub.

Coyne, R. (2010). *The tuning of place: sociable spaces and pervasive digital media* MIT Press.

Crawford, A. (2008). Taking Social Software to the Streets: Mobile Cocooning and the (An-)Erotic City. *Journal of Urban Technology, 15*(3), 79 - 97.

Davidson, R. M., Martinsons, M. G., & Kock, N. (2004). Principles of canonical action research. *Information Systems Journal, 14*, 65-86.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 319-340.

de Moor, A. (2007). Using System dynamics to construct design theory for community information systems. *The Journal of Community Informatics, 3*(1).

De Souza e Silva, A. (2006). From Cyber to Hybrid: Mobile Technologies as Interfaces of Hybrid Spaces. *Space and Culture, 9*(3), 261-278.

Dourish, P. (2006). *Implications for design.* Paper presented at the CHI 2006, Montreal, Quebec, Canada.

Dourish, P. (2007). *Responsibilities and implications: further thoughts on ethnography and design.* Paper presented at the Conference on Designing for User eXperiences 2007, Chicago, Illinois

Dourish, P., & Bell, G. (2007). The infrastructure of experience and the experience of infrastructure: meaning and structure in everyday encounters with space. *Environment and Planning B: Planning and Design, 34*(3), 414 – 430.

Figueiredo, A., & Cunha, P. (2006). Action research and design in information systems: two faces of a single coin. *Information Systems Action Research: An Applied View of Emerging Concepts and Methods. Springer*.

Forlano, L. (2009). WiFi Geographies: When Code Meets Place. *The Information Society: An International Journal, 25*(5), 344 - 352.

Foth, M. (2006). Network action research. *Action Research, 4*(2), 205-226.

Foth, M. (2009). *Handbook of research on urban informatics : the practice and promise of the real-time city*. Hershey, PA: Information Science Reference.

Foth, M., & Adkins, B. A. (2006). A Research Design to Build Effective Partnerships between City Planners, Developers, Government and Urban Neighbourhood Communities. *Journal of Community Informatics, 2*(2).

Foth, M., & Axup, J. (2006). *Participatory Design and Action Research: Identical Twins or Synergetic Pair?* Paper presented at the Participatory Design Conference 2006: Expanding Boundaries in Design.

Foth, M., Choi, J., & Satchell, C. (2011). *Urban informatics*. Paper presented at the ACM Conference on Computer Supported Cooperative Work (CSCW 2011).

Foth, M., Satchell, C., Bilandzic, M., Hearn, G. N., & Shelton, D. (2012). Dramatic character development personas to tailor apartment designs for different residential lifestyles *From Social Butterfly to Engaged Citizen: Urban Informatics, Social Media, Ubiquitous Computing, and Mobile Technology to Support Citizen Engagement*.

Gordon, E., & de Souza e Silva, A. (2011). *Net Locality: Why Location Matters in a Networked World*. Boston: Blackwell-Wiley.

Gregor, S., & Jones, D. (2007). The Anatomy of a Design Theory. *Journal of the Association for Information Systems, 8*(5), 312-335.

Gurstein, M. (2003). Effective use: A community informatics strategy beyond the digital divide. *First Monday, 8*(12), 1-18.

Gurstein, M. (2007). *What is community informatics (and why does it matter)?* Milan, Italy: Polimetrica.

Gurstein, M. (2010). Towards An Urban Community Informatics. Retrieved 21 June, 2011, from http://gurstein.wordpress.com/2010/08/28/towards-an-urban-community-informatics-movement/

Hagen, P., & Robertson, T. (2009). *Dissolving boundaries: social technologies and participation in design*.

Hagen, P., Robertson, T., Kan, M., & Sadler, K. (2005). *Emerging research methods for understanding mobile technology use*. Paper presented at the Proceedings of the 17th Australia conference on Computer-Human Interaction: Citizens Online: Considerations for Today and the Future.

Hearn, G., & Foth, M. (2005). Action Research in the Design of New Media and ICT Systems. In K. Kwansah-Aidoo (Ed.), *Topical Issues in Communications and Media Research* (pp. 79-94).

Hevner, A., March, S. T., Park, J., & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly, 28*(1), 75-105.

Hornecker, E., Halloran, J., Fitzpatrick, G., Weal, M., Millard, D., Michaelides, D., et al. (2006). *UbiComp in opportunity spaces: challenges for participatory design*. Paper presented at the Proceedings of the ninth conference on Participatory design: Expanding boundaries in design - Volume 1.

Hughes, J., King, V., Rodden, T., & Andersen, H. (1995). The role of ethnography in interactive systems design. *Interactions, 2*(2), 65.
Humphreys, L. (2010). Mobile social networks and urban public space. *New Media & Society, 12*(5), 763-778.
Iivari, J. (2003). The IS Core-VII: Towards Information Systems as a Science of Meta-Artifacts. *Communications of the Association for Information Systems, 12*.
Iivari, J., & Venable, J. (2009). *Action Research and Design Science Research - Seemingly similar but decisively dissimilar*. Paper presented at the European Conference on Information Systems (ECIS 2009).
Israel, B. A., ASchulz, A. J., Parker, E. A., & Becker, A. B. (1998). REVIEW OF COMMUNITY-BASED RESEARCH: Assessing Partnership Approaches to Improve Public Health. *Annual Review of Public Health, 19*, 173-202.
Jacobs, J. (1961). *The Death and Life of Great American Cities*. New York: Random House.
Jarvinen, P. (2007). Action research is similar to design science. *Quality and Quantity, 41*(1), 37-54.
JoCI. (2007). Journal of Community Informatics, Special Issue: Community Informatics and System Design, Vol 3 No 1. from http://ci-journal.net/index.php/ciej/issue/view/16
Kensing, F. (2003). *Methods and Practices in Participatory Design*. Copenhagen, Denmark: IT University Press.
Klaebe, H. G., Adkins, B. A., Foth, M., & Hearn, G. N. (2009). Embedding an Ecology Notion in the Social Production of Urban Space. In M. Foth (Ed.), *Handbook of Research on Urban Informatics: The Practice and Promise of the Real-Time City*: Information Science Reference, IGI Global.
Lefebvre, H. (1991). *The production of space* (D. Nicholson-Smith, Trans.). Oxford: Blackwell.
Lentini, L., & Decortis, F. (2010). Space and places: when interacting with and in physical space becomes a meaningful experience. *Personal and Ubiquitous Computing*, 1-9.
Lewin, K. (1951). *Field Theory in Social Science*. New York: Harper & Bros.
Lozanovska, M. (1989). Gender and architecture in a Macedonian village. *Exedra, The Journal of the School of Architecture, Deakin University, 1*(2), 26.
Lozanovska, M. (2002). Architectural Frontier/Spatial Story: The Problematic of Representing the Everyday *Space and Culture, 5*(2), 140-151.
March, S., & Smith, G. (1995). Design and natural science research on information technology. *Decision Support Systems, 15*(4), 251-266.
Massey, D. (1991). A global sense of place. *Marxism today, 35*(6), 24-29.
McCarthy, J., & Wright, P. (2004). *Technology as experience*. Cambridge, Mass.: MIT Press.
Meyrowitz, J. (2005). The rise of glocality: new senses of place and identity in the global village. *A sense of place: The global and the local in mobile communication. Vienna: Passagen Verlag*, 21-30.
Minkler, M., & Wallerstein, N. (Eds.). (2003). *Community Based Participatory Research for Health*. San Francisco: Jossey-Bass.
Mumford, E., Hirschheim, R., Fitzgerald, G., & Wood-Harper, T. (Eds.). (1985). *Research Methods in Information Systems: Proceedings of the IFIP WG 8.2 Colloquium, Manchester Business School, Manchester, UK, 1-3 September 1984*. Amsterdam: North Holland.
Norman, D. A. (1999). Affordance, conventions, and design. *Interactions, 6*(3), 38-41.
Nunamaker, J. F. J., Chen, M., & Purdin, T. D. M. (1991). Systems Development in Information Systems Research. *Journal of Management Information Systems, 7*(3), 89-106.
Oldenburg, R., & Brissett, D. (1982). The third place. *Qualitative Sociology, 5*(4), 265-284.
Orlikowski, W., & Iacono, C. (2001). Desperately seeking the 'IT' in IT research-a call to theorizing the IT artifact. *Information systems research, 12*(2), 121-134.
Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2008). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems, 24*(3), 45-77.

Pitkin, B. (2001). *Community informatics: hope or hype?*
Poslad, S. (2009). *Ubiquitous Computing: Smart Devices, Environments and Interactions*: Wiley & Sons.
Project for Public Spaces. (2000). *How to Turn a Place Around*: Project for Public Spaces Inc.
Putnam, R. D. (1995). Bowling Alone: America's Declining Social Capital *Journal of Democracy, 6*(1), 65-78.
Relph, E. (1976). *Place and placelessness*. London: Pion.
Satchell, C., & Dourish, P. (2009). *Beyond the user: use and non-use in HCI*. Paper presented at the Proceedings of the 21st Annual Conference of the Australian Computer-Human Interaction Special Interest Group: Design: Open 24/7.
Schmidt, A., Langheinrich, M., & Kersting, K. (2011). Perception beyond the Here and Now. *Computer, 44*(3), 86-88.
Schneekloth, L. H., & Shibley, R. G. (1995). *Placemaking : the art and practice of building communities*. New York: Wiley.
Schroeter, R., & Foth, M. (2009). *Discussions in space.* Paper presented at the OzCHI 2009, Melbourne, Australia.
Schroeter, R., & Houghton, K. (2011). *Neo-planning: location-based social media to engage Australiaís new digital locals*.
Schuler, D., & Namioka, A. (1993). *Participatory design: Principles and practices*. Hillsdale, New Jersey, USA: Erlbaum.
Sein, M., Henfridsson, O., Purao, S., Rossi, M., & Lindgren, R. (2011). Action Design Research. *Management Information Systems Quarterly, 35*(1), 37-56.
Soja, E. W. (1996). *Thirdspace: journeys to Los Angeles and other real-and-imagined places*. Cambridge, Mass.: Blackwell.
Susman, G., & Evered, R. (1978). An assessment of the scientific merits of action research. *Administrative Science Quarterly, 23*, 582-603.
Tacchi, J., Foth, M., & Hearn, G. (2009). Action research practices and media for development. *Journal of Education and Development Using Information and Communication Technology, 5*(2).
Tacchi, J., Slater, D., & Hearn, G. (2003). *Ethnographic Action Research*. New Delhi: UNESCO New Delhi.
Taylor, A. S. (2009). Ethnography in Ubiquitous Computing. In J. Krumm (Ed.), *Ubiquitous Computing Fundamentals* (pp. 203-236): Chapman & Hall / CRC.
Tuan, Y.-f. (1977). *Space and place: the perspective of experience*. Minneapolis: University of Minnesota Press.
Vaishnavi, V., & Kuechler, W. (2004). Design Research in Information Systems. Retrieved October 2, 2004, from http://www.isworld.org/Researchdesign/drisISworld.htm
Venable, J. (2005). *Coloured Cognitive Maps for Modelling Decision Contexts.* Paper presented at the First International Workshop on Context Modeling and Decision Support, Paris, France.
Venable, J. (2006a). A Framework for Design Science Research Activities. *Proceedings of the 2006 Information Resource Management Association Conference (CD ROM), Washington, DC, USA, 21-24 May 2006.*
Venable, J. (2006b). The Role of Theory and Theorising in Design Science Research. *Proceedings of the First International Conference on Design Science Research in Information Systems and Technology, Claremont, CA, USA, 24-25 February, 2006*, 1-18.
Venkatesh, V., Davis, F. D., & Morris, M. G. (2007). Dead Or Alive? The Development, Trajectory And Future Of Technology Adoption Research. [[electronic resource].]. *Journal of the Association for Information Systems, 8*(4), 267-286.
Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quaterly, 27*(3), 425-478.
Wadsworth, Y. (1998). What is Participatory Action Research? *Action Research International*.

Wallerstein, N., & Duran, B. (2010). Community-Based Participatory Research Contributions to Intervention Research: The Intersection of Science and Practice to Improve Health Equity. *American Journal of Public Health, 100*(S1), S40-S46.

Walljasper, J. (2007). *The Great neighborhood book : a do-it-yourself guide to placemaking*. Gabriola Island, B.C.: New Society Publishers.

Walls, J. G., Widmeyer, G. R., & El Sawy, O. A. (1992). Building an information system design theory for vigilant EIS. *Information Systems Research, 3*(1), 36-59.

Watters, E. (2004). *Urban tribes: are friends the new family?* London: Bloomsbury.

Wellman, B. (2002). Little Boxes, Glocalization, and Networked Individualism. In M. Tanabe, P. van den Besselaar & T. Ishida (Eds.), *Digital Cities* (Vol. LNCS 2362, pp. 10-25). Heidelberg: Springer.

Whyte, W. F., Greenwood, D. J., & Lazes, P. (1989). Participatory Action Research. *American Behavioral Scientist, 32*(5), 513-551.

Whyte, W. H. (1980). *The Social Life of Small Urban Spaces* The Conservation Foundation.

Willis, K. (2007). Situated Interactions: Spatial Setting and Mobile and Wireless technologies. In U. Taylor and Page (Ed.), *Encyclopaedia of Mobile and Wireless Communications*: Taylor and Page, US.