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# Multi-Method Approach to Guide Design and Use of ICT Infrastructure Services

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# MULTI-METHOD APPROACH TO GUIDE DESIGN AND USE OF ICT INFRASTRUCTURE SERVICES

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## Abstract

*Traditional design methods cannot fulfill on the rich scope of requirements when designing complex services for modern ICT environment. Multi-method approaches to requirements data collection bear a promise to offer a better understanding of complexities related to information technologies, but lack established theoretical frameworks to guide the research work.*

*Drawing on theories of social learning, sense-making, consumer research, and ethnographical studies of infrastructure, we propose a multidisciplinary theoretical framework to guide a multi-method data collection for obtaining better insights into inter-related roles of ICT uses and contexts in which use decisions and consumption takes place.*

*Keywords: Multi-method research, multidisciplinary theoretical framework, Information Society, infrastructure, design, use, ICT service*

## 1 INTRODUCTION

The IS paradigm has undergone a substantial change since the introduction of the discipline, reflecting the growth of IS from in-house mainframe computers to worldwide distributed network of Information and Communication Technologies (ICT) (Schneberger & McLean, 2003). At the same time, the theories and methods guiding design practice have remained virtually untouched (Fitzgerald, 2000).

One particular novel domain in IS research agenda originated from the informatization movement, which started in Japan in the late 1980s (Castells, 1996), and became an official part of political rhetoric in the U.S. and Europe in the 1990s (Kahin, 1998). After almost two decades, this new rubric of IS development came to be known as Information Revolution, or a task of building Information Society. In the heart of Information Societies of the post-industrial world lie pervasive national information processing and communication infrastructures (Castells, 1996, p.29), otherwise known as Information Infrastructures.

Every year, different benchmarks are applied to show ever growing measures for nation states' abilities to participate in the Information Revolution. For example, in the Information Society Index (The WorldPaper, 2003b; 2003a) and the Digital Access Index (DAI) (ITU, 2003) Scandinavian countries comes on top. DAI measures the overall ability of individuals in a country to access and use ICT products and services, taking into account five variables: infrastructure, affordability, knowledge, quality, and usage. All benchmarks combined, official rhetoric portrays Scandinavians being well equipped in terms of availability of both technical infrastructure for provision of advanced ICT services, knowledge on how to access and use these services, and means to pay for it.

On the backdrop of the more than positive rhetoric of Information Society development, IS scholars report that design process that leads to the creation of ICT products and services at virtually any level, from in-house information systems (Ramiller, 2005) to national ones (Hanseth et al., 2006), have become increasingly prone to failures. Empirical findings report on a spectrum of issues, among which are the following:

- Focus in developing service infrastructure is almost always on the producers of ICT systems and services, but not on the citizens or end-users (Ilshammar et al., 2005, p.36).

- Provision of advanced data services to the citizens is often driven by political rationale (Lines, 2005).
- The way behavioral and consumer research is conducted in the telecommunication service arena is that researchers gather information about user interests and perceptions piecemeal, thus often failing to appreciate the context in which telecommunication service decisions and consumption takes place (Katz, 1999; Aakhus, 2003, p.30).
- The availability of often very complex services does not necessarily reflect the extent to which people are using the services, and the percentage of population using the services (Daniel & Wilson, 2003, p.285).
- People tend not to understand or believe that available ICT services are meaningful solutions to their communication problems related to time and coordination despite the availability (Aakhus, 2003, p.28).
- There is a lack of proper measurement methods for the success of ICT product implementation – all rankings exclusively focus on the supply of services, and fail to look at the demand side of services (Andersen et al., 2005).
- Due to the lack of proper measurement methods, new services development that has been reported as successful, often shows use levels below any expectations (Henriksen & Mahnke, 2005).
- Finally, even well designed and implemented services can be subject to deterred use due to the residue of social behavior (Jessup & Robey, 2002).

It is our scholarly obligation to respond to the voiced criticism on design of ICT products and services for the Information Infrastructure. One implication we draw from the aforementioned criticism is the need for a multidisciplinary and multi-method approach to the design practice for complex modern environment. In this paper we propose a theoretical framework which brings together multiple theories related to ICT infrastructure services design and use, and can be used to guide multi-method approach to studying the design and use of ICT services. To demonstrate the usefulness of the chosen approach, we report on our own experience with using the framework and multi-method in a study on the (low) usage of advanced mobile data services.

## **2 RESEARCH MOTIVATION**

### **2.1 Participant observation as motivation for case study**

In this paper we present findings of the case study on the actual (non-) use of mobile data services by citizens of the city of Copenhagen. The original case study was inspired by the publication of Leonard Jessup and Daniel Robey (2002), in which the authors used anecdotes to demonstrate what advanced service possibilities are afforded by ubiquitous technology as contrasted to the residue of social behavior. One of such anecdotes of social behavior was observed at a public bus stop in the capital of Denmark, during one of the winter days. On that specific day public bus drivers were on strike and the transportation services were disrupted, which resulted in situations where people gathered at a bus stop were waiting for a bus for more than 30 minutes longer than expected without knowing the certain time for the bus' arrival. Participant observation of the waiting people and personal experience of the lead author as an advanced user and knowledgeable scholar of cellular mobile telephony technology allowed to suggest initial hypothesis (Weick, 1993) on the lower-than-official-rhetoric-tells usage of mobile data services and triggered the initial interest (Weick, 1989) in conducting the case study.

The original inquiry was aimed at examining the reasons for the low use of mobile cellular data services in the specific circumstances, when uses of services would benefit the citizens. The specific services referred to as beneficial, are bus arrival time information. This kind of situations are presented in organizational studies using sense-making theory – in situations of uncertainty people seek information to make sense of the unfamiliar environment (Weick, 1993). In the specific situation observed, the sought for information – the arrival time for the next bus – was available and accessible via cellular mobile phones over a number of media channels (voice, SMS, mobile Internet /WAP). Despite the availability of services, a very low usage was observed. In other words, people did not take

advantage of available services, which was at odds with the official rhetoric on the state of Danish Information Society, and which motivated the authors to seek for explanations of such behavior and suggest how designers and promoters of ICT services can stimulate the service use in the future.

As the research on the case study advanced, it became clear that a single-method data collection approach wouldn't cater to answering the research question. As the authors engaged in data collection, a need for appropriate research model to guide data collection and interpretation was identified. In the remaining of the paper, we report on the chosen research framework and multi-method data collection approach.

## 2.2 Theory and practice of design

In human cultures, almost all values inhere in designs (Baldwin & Clark, 2005). In general terms, *designs* are the instructions that turn knowledge into things that people value and are willing to pay for (Baldwin & Clark, 2005, p.3). In the IS/ICT jargon, *design* is a process where various interests are translated into technological solutions as well as organizational arrangements and procedures to be followed, to make the technology work properly (Aanestad & Hanseth, 2000). Thus, the success of designing advanced information services for citizens becomes a central issue for any information society. Given the importance of design, the question is how scholarly domain can contribute to betterment of design practices?

Problem-solving task of design process is that of (1) requirements engineering (RE) and ICT artifact (or service) implementation for (2) consequent adoption and use by organization or citizens. Requirements engineering is an established scholarly and practitioners discipline (Davis, 1993; Macaulay, 1996), which is based on two key assumptions: "One is that requirements exist 'out there' in the minds of stakeholders (users, customers, clients), and they can be elicited through various mechanisms and refined into complete and consistent specifications. The second is that the key stakeholders operate in a state of goal congruence, in which there is widespread and coherent agreement on the goals of organization" (Bergman et al., 2002, p.154). Seeing the wide range of criticism on design of Information Infrastructures, we can infer that in reality there is a discrepancy between the theoretical and practical aspects of RE.

With regard to elicitation of requirements, empirical studies report the practice of collecting information on user interests and perceptions is often piecemeal (Katz, 1999). As a result, discovered innovation requirements do not appreciate the context in which ICT service decisions and consumption takes place (Aakhus, 2003, p.30). Involvement of projected end-users in usability tests results in measuring what people *can* do with the novel services, not if people *will* use them in specific circumstances (Dillon, 2000). When actual end-users fall under the research lens in studies of ICT services, reliance on indirect questionnaire methods renders those studies inadequate (Davis & Luthans, 1980, p.285). In other words, when concerns for usability and usefulness (Davis, 1989) of services being developed are used to guide research leading to product or service development, assumptions made about users and their choice are often removed from social and technology environment contexts (Lamb & Kling, 2003; Cushman & Klecun, 2006).

With regard to the "goal congruence" among stakeholders, our specific study shows an inherently complex relationship between the key promoters of the innovation, implicated in public-private partnerships, political decisions on budget allocations for the development and promotion of service, service outsourcing, etc.

For the designed product to be successfully adopted, design process, in addition to requirements engineering (Bergman et al., 2002), must be guided by multitude of factors. It must cater for engineering of objects (Bijker, 2001), aesthetics (Lyytinen, 2004), usefulness and usability (Davis, 1989; Orlikowski, 2004), market placement (Silverstone & Haddon, 1996), and other concerns. Thus, the design process consists of the large number of elements, interaction among which is rich, any element in the process influencing a few other ones (Cilliers, 1998, p.3).

The process of design for ICT infrastructures is further complicated by critical role of existing technology designs, or so-called "installed base" (Ciborra et al., 2001). The notion of *installed base* is

closely related to the characteristic of the complex system as having history, where complex systems' "past is co-responsible for their present behaviour" (Cilliers, 1998, p.4). The use of available (novel) services is also subject to people's past experiences with similar services and/ or established cultures of consumption (Jessup & Robey, 2002; Shove & Pantzar, 2005). Although economic considerations in technology innovation often play a decisive role (Besen & Farrell, 1994), production and consequent use of a new ICT service or product depends on wide variety of issues, implicated by "politics of adjustment and negotiation between engineers, entrepreneurs, managers, salesmen, experts, laymen, journalists, scientists, showmen and users – as together they stumble their way towards the newly possible" (Silverstone & Haddon, 1996, p.47).

The failure of design scholars and practitioners to embrace the nature of interaction between the elements, the failure to embed the correct user values in design (Baldwin & Clark, 2005), is perceived as a "design problem" (Williams et al., 2005), which leads to low adoption rates (or rejection) of innovation.

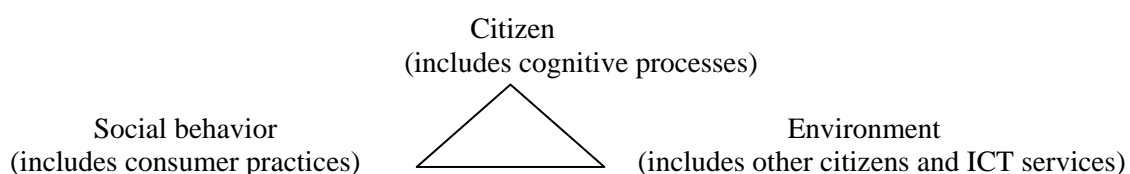
Thus, it is not the lack of methodological knowledge which is the primary obstacle for the success of system development (Mathiassen & Purao, 2002, p.84), but failure to grasp the complexity of the context (Benbya & McKelvey, 2006) in which novel services are to be used, as well as inter-relationship between the micro- and macro-contexts of use (Fomin, 2002). Given the presented complexity of the design process and the ICT environment, it is appropriate to study innovation process "in a dynamic context that... has internal, external, and historical dimensions" (Boddy & Paton, 2005, p.142). Design task in such context requires identification of a broad "assembly of forces" (Latour, 1987) that tie together technology, organizational, social, regulatory and market aspects of the environment (Fomin, 2002). This in turn, requires multidisciplinary theoretical frameworks able to integrate multiple theories in a meaningful manner (Sawyer, 2001; Weick, 1995) and guide the data collection needed for untangling user interests and preferences for (betterment of) product design.

### 3 RESEARCH SETUP AND METHODS

#### 3.1 Theoretical framework

Because of the sheer size and complexity of any infrastructure, it can be studied adopting different scales of time, space, and social organization, each producing different pictures of how infrastructure develop, as well as its constraining and enabling effects on the citizens (Edwards, 2003, p.220). Different scalar views lead to different understanding of the "modernist settlement" (Latour, 1999, p.14) that brings together technology and society (Edwards, 2003, p.221). Given the aforementioned difficulties, a multidisciplinary theoretical framework is needed to establish linkages among different bodies of theories pertaining to different aspects of ICT infrastructure service development and use, and for guidance on how to develop multiple data sets informing the design requirements (Sawyer, 2001, pp.169-170).

In this paper we propose to conceptualize the Information Society as a "structure", defined by three dimensions – the environment in which the novel products or services are produced and are to be used (including the various infrastructures and the services they provide), the citizens (as users of the old and new services), and citizens' behavior (See *Figure 1*).



*Figure 1. The socio-technical structure of Information society as a social learning system. Adapted from (Davis & Luthans, 1980, p.283).*

This conceptualization is informed by the social learning approach to organizational behavior studies, which focus on reciprocal interaction between behavior, cognitive processes and the environment (Davis & Luthans, 1980). In social learning approach, social behavior is viewed as affecting and being affected by the participant's cognitions, the environment, and the person-situation interactions (Davis & Luthans, 1980, p.283). This means that citizens' decisions with regard to use of newly developed services will depend not only on the service's technological perfection (which is often seen as the aim of design process), but on practices and associated cultures of consumption (Shove & Pantzar, 2005), which are always related to previous related practices. Introduction of new services or products will only succeed, if what is considered as "normal" practice in the minds of people (Weick, 1993) can be directed towards the innovative product or service (Huysman et al., 1994).

Compared to the traditional requirements engineering methods, the proposed framework caters for better representation of forces that govern behavior (and expectations) of citizens vis-à-vis ICT products and services in the modern society. It shifts the research focus from "situation-free people with broad trait adjectives to analyzing the specific interactions between conditions and the cognitions and behaviors of interest" (Davis & Luthans, 1980, p.287). It transcends scalar views on infrastructure development by allowing to simultaneously account for micro- and macro-aspects of the environment and use behavior. We argue that the proposed framework and reported multi-method help addressing the issue of "user-free" design rationale of ICT infrastructure (Flak et al., 2005) and thus contribute to the betterment of design for information infrastructures.

### 3.2 Research methods and data collection

Among the sources of evidence used for the original study were participant observation, statistical records on data and phone usage, interviews, personal experience, and newspaper and company publications.

Participant observation (Ellwood, 1924) occurred during one of the days of bus drivers' strike at a bus stop with more than 20 people waiting for a bus much longer than expected.

Personal experience of the lead author as an advanced user and knowledgeable scholar of mobile telephony technology allowed him to suggest initial hypothesis (Weick, 1993) on the lower-than-official-rhetoric-tells usage of mobile data services. In situ observation also triggered the initial interest (Weick, 1989) in conducting the case study.

Early on in the study it became clear that in order to recreate the picture of complex "puzzle" of mobile data services provision and use, a multi-method approach to data collection must be used. Multi-method research is based on the premise that analysis of separate data sets drawn on the same phenomena will provide a richer picture of the research object than will any single method (Sawyer, 2001, p.163). The process of combining multiple data sets is often called triangulation – an analytic act of identifying similar findings from different data sets (Sawyer, 2001, p.165).

Multi-method-based research on ICT remains an under-explored area in IS domain (Sawyer, 2001, p.163), one consequence of which is the lack of coherent techniques for guiding the research work. Given the role of theory in multi-method research – that of a source of guidance on how to develop multiple data sets by helping researcher focus on the types of data needed (Sawyer, 2001, p.169), we first have chosen the theoretical framework, which has been subsequently tested through the case study. The chosen framework allowed to piece together disparate theoretical perspectives and obtain a plausible explanation of the observed phenomena (Weick, 1995).

Consequently, the Greater Copenhagen Transportation Authority (HUR)<sup>1</sup> was contacted in order to obtain data on the availability and usage of different media channels offering information on times tables, routes, etc. Short telephone interviews with HUR employees responsible for mobile data portal and customer call centre were conducted. Data collection was complemented by newspapers publications on the consequences of the strike and statistics from HUR's annual report.

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<sup>1</sup> The corporate name has recently been changed to Movia ([www.movia.dk](http://www.movia.dk)).

Statistical and interview data did not cater for understanding of motivation to use or not to use a specific available service was not there. Therefore, additional data collection methods were deployed, such as a web-based survey and simple linear regression analysis on the use of mobile phones in specific situations. The survey, which generated more than 900 responses where nearly 50 percent of respondents reported to have been affected by the strike, provided insights on the use-aspect of mobile data services. The regression analysis allowed testing the relationship between specific environment conditions and use of mobile data services.

In the following sections we describe which data collection methods were used for each of the three variables of the adopted theoretical framework, and which results obtained using each specific method.

### 3.2.1 The environment

To study the environment is to study the available services, the technology development trends, and consumer practices. Technology-related modalities of the modern Information Society environment can be studied using statistical data, research publications and data from inquiries to relevant organizations. Studies of consumer practices can additionally deploy direct observation and survey methods (see Table 1).

Relying on data obtained from statistical records and indicators on the specific ICT environment and consumer practices are rather ambiguous. On the one hand, the availability of technology and services is almost ubiquitous. On the other hand, the technological readiness of the environment is not reflected in the actual consumer practice.

Issue / data collection method	Data obtained
<p><b>Technology development trends.</b> Qualitative analysis: scholarly publications, statistical reports and indicators.</p>	<p>Denmark is among the top nations in the development of Information Society, where not only there is an adequate infrastructure for ICT services provision, but also the needed knowledge on the use of services and the services are affordable for the population (ITU, 2003; The WorldPaper, 2003b; 2003a). The number of data-enabled cellular mobile subscriptions in Denmark at the end 2005 reached 70 percent (National IT and Telecom Agency, 2005). The cellular mobile data traffic in Denmark has grown exponentially, from zero Mega Bytes (MB) in the first half of 2002 to 7.575.868 MB by the end of 2005 (National IT and Telecom Agency, 2005).</p>
<p><b>Available services.</b> Qualitative analysis: statistical reports and indicators, company telephone interviews, practical experience with cellular mobile phones.</p>	<p>Public buses' time tables at the time when research work was conducted was available to the owners of cellular mobile handsets (or wireless internet enabled PDAs) through three different information channels – the voice, SMS, and the mobile Internet</p>
<p><b>Consumer practice.</b> Qualitative analysis: statistical data, company publications, telephone interviews.</p>	<p>Average use pattern of the three communication channels, as a ratio of potential users to actual users is 0.32 percent for voice, 0.02 percent for mobile Internet, and 0.005 percent for SMS.<sup>2</sup></p>

Table 1. Data collection methods to study the Danish environment of the cellular mobile data services

### 3.2.2 The behavior

Understanding the use-related behavior of people in situations, when the use of ICT services is not only permitted by the environment, but also considered as beneficial due to specific circumstances, can help inform better design of existing and future services. Studying social behavior can be done by collecting statistical data and performing quantitative analysis on it. However, this approach has been

<sup>2</sup> All numbers on media choice are authors' own calculation based on statistical data.

criticized as being inadequate (Davis & Luthans, 1980; Ellwood, 1924). While statistical data are very helpful in understanding the trends in use behavior, in situ observation of people's behavior in specific situations will give better-informed ideas to designers of novel services. In situ observations can inform on the *immediate* environment, in which the social action (and human-technology interaction) takes place, as opposed to *generalized* environment, represented by statistical numbers.

Deploying direct observation method is justified by two different yet relevant bodies of literature. First, a micro-perspective on the ICT infrastructure development (Star, 1999) postulates that the way ICT services and products are used is affected by everyday interactions of citizens with the immediate environment. Second, consumer research suggests that consumer behavior is always homegrown, peoples' behavior always being rooted in historical and geographical contexts (Shove & Pantzar, 2005), and hence the immediate environment their daily routines take place in.

Combining data from archival records and statistical indicators with direct *in situ* observations of citizens' behavior establishes a viable link between the environment and the behavior (see Table 2 and Figure 1 above). Given the specific context of mobile data services analysis, it must be also noted that characteristics of the immediate environment influence the communicative behavior of people. People gathered at a bus stop can be categorized as a "temporary group in the early stages of its history" (Weick, 1993, p.644). People in this type of group will not likely engage in face-to-face communication, but rather seek information from outside by e.g., using a mobile phone to call somebody they trust can be helpful (Weick, 1993, p.644).

Issue / data collection method	Data obtained
<p><b>The immediate environment.</b> Participant observation: in situ observation of people's behavior and their immediate environment.</p>	<p>In the immediate environment of the bus stop, there was information available on how traffic information can be obtained using the voice channel (there was a phone number for the customer service centre at the information poster at the bus stop). However, the phone number was in a small print on a huge poster featuring schematic map of the Greater City of Copenhagen and all the public transportation routes. People would have to look rater carefully at the information poster to locate the needed number.</p> <p>There was no information available on how other communication channels (e.g., SMS or mobile Internet) can be used to obtain the traffic information service.</p> <p>Given the waiting people had knowledge on how voice, SMS or mobile Internet service can be used to obtain the traffic information, using one of those services would have been an easy and affordable way to find out about the arrival time for the next bus.</p>
<p><b>Situation specific use behavior.</b> Participant observation: in situ observation of people's behavior. Quantitative analysis: using statistical data (including regression analysis), telephone interviews.</p>	<p>While the use of voice, SMS or mobile Internet service was an easy and affordable way to find out about the arrival time for the next bus, people either did not use their mobile phones at all, or used them to engage in time-killing activities. Some sent SMS or placed phone calls, although apparently not to one of the service numbers.</p> <p>In the specific circumstances, the ratio of potential users of services to citizens who actually did take advantage of the available services was 3.23 percent for voice media, and 0.09 percent for mobile Internet (five to 10 times the regular average).<sup>3</sup></p> <p>A simple linear regression analysis of data with the specific circumstances as a dummy variable showed that 19.7% of the variance in using mobile Internet for accessing the service was accounted for (constant 109,82, B1 = 52,03, df=57, t=3.74, p&lt;0,001).</p>

Table 2. Data collection methods to study situation specific service use behavior

<sup>3</sup> All numbers on media choice are authors' own calculation based on statistical data.



### 3.2.3 The citizen

In situ observation of social behavior enhanced the picture of how information services are used in specific circumstances. Performing quantitative analysis of statistical data allowed to address the issue of generalizability – whether or not the recorded higher usage rate on the strike day were unique, or characteristic of any days when transportation services were disrupted.

However, the discrepancy between the technology- and environment- afforded services and the actual extent to which services are used, called for further investigation into the motivation of citizens for not using the services. Understanding of consumer attitudes and images associated with certain products or services can provide a substantial contribution to the betterment of existing and future services (Shove & Pantzar, 2005). In other words, for service and product designer it is important to know whether the services in question are not used because they are not perceived as useful (in specific circumstances or in general), or because potential users lack information on how the services can be used. Obtaining insights on cognitive aspects related to service’s use can be done by deploying survey method (see Table 3).

Issue / data collection method	Data obtained
<p><b>Preferred media channels.</b>            Online web-survey: media channel choice preferences in situations of uncertainty.            Participant observation: in situ observation of people’s behavior.</p>	<p>The following information channels are preferred choices (1 to three, among 8 choices available) for obtaining public transport information for more than 50 percent of respondents: #1 - Internet web pages (32%) and printed time tables at the transportation stops (24%); #2 - printed time tables (22%), mobile Internet accessible time tables (15%), other people at the stop (14%), and Internet web pages (14%); #3 - other people at the stop (21%), text TV (teletext) (15%), and SMS inquiry (12%).</p> <p>In the specific circumstances, the use of mobile Internet or SMS to obtain the needed services (the arrival time for the next bus) was choice #1 only for 25 and 18 percent of responds, correspondingly, while it was choice #6 (the last among 6 choices available) for 34 and 14 percent, correspondingly.</p> <p>Over 65 percent of people did not use cellular mobile devices to take advantage of the available services at all, while over 20 percent used mobile phones to call or SMS their colleagues or friends, instead of using the available service.</p>
<p><b>Reasons for not using the available services.</b>            Online web-survey: media channel choice preferences in situations of uncertainty.            Qualitative analysis: post-survey interviews.</p>	<p>Over 70 percent of respondents consider the fee of 20 eurocents charged by the public transportation authority for providing real-time busses timetables over SMS or mobile Internet channels to be unreasonably high.</p> <p>The reasons for not using the services were the lack of awareness of availability of services and the lack of information on how services can be accessed.</p>

Table 3. Data collection methods to study citizens’ attitudes towards the use of available services

## 4 CONCLUSIONS

The political rational, the exponential growth of mobile data traffic, and the nearly ubiquitous availability of mobile-data enabled phones in Denmark may have stimulated the public transportation authority to design and implement time table information services to be accessible via mobile Internet. However, not taking into consideration social and cognitive aspects of service design features may be failure-prone. Our study should motivate scholars and practitioners of design to use multi-method approach to data collection, triangulating findings obtained by indirect inquiry methods with e.g., *in situ* observations, or consumer surveys and interviews (Davis & Luthans, 1980; Ellwood, 1924).

By integrating theories of infrastructural development, sense-making, social learning, as well as consumer research in a single framework, we are able to conceptualize the daily interactions of citizens vis-à-vis ICT services as a structure, defined as “a complex medium of *control* which is

continually produced and recreated in interaction and yet shapes that interaction” (Weick, 1993, pp.644-645, emphasis added). While the official rhetoric on advancement of ICT services is guided by the *control* rationale – citizens must be given ever-more efficient mechanisms to organize their daily routines, especially, when something in the environment is perceived as “out of control” (Council of the European Union, 2002) – prior research suggests people do not consider ICT services as meaningful control solutions (Katz, 1999). The proposed framework presents the users of the services, their intentions and consumer practices, and the environment in which they live, work, and interact, as reciprocally interrelated, which can help guide design of more useful ICT services.

One way the chosen framework helps inform better design practice is by guiding multi-method data collection – an under-explored practice in the IS research domain – towards “developing better insights into, and more useful theories of, the inter-related roles of ICT’s uses, and the formal and informal social organizations into which they are embedded” (Sawyer, 2001, p.180). The lack of understanding of users’ needs is a well known reason for product innovations failures (Schot, 2003).

Due to the complex nature of modern ICT environment, and the complex interactions between the use environment and the products, different modalities of a service or product design and use cannot be predicted. However, due to the specifics of infrastructure service development where new products and services, as well as associated consumer behaviors, are dependent on the available technology installed base and previous patterns of use, user interests and perceptions can be obtained from real-life situations of user-technology-environment interactions for existing products and services. Such approach would allow engaging real users as more than test participants (Lamb & Kling, 2003; Dillon, 2000), and have designers exposed to the real contexts of use (Dillon, 2000).

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