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Navigating Multi-modal Public Transport Systems: Real time perceptions of processual usability using video methodology

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Abstract

Collection of data of customer processes are difficult, due to its dynamic and complex nature. This study reports on some initial findings using a video-based methodology in collecting naturally occurring visual data of travellers using different modes of transport (bus, tram, train, boat, subway) in Stockholm City. The study involves able-bodied and disabled travellers (customers) and identifies environmental and processual factors that are critical for the passengers handling multimodal door-to-door trips.

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1. Introduction

In everyday life people are occupied with different activities in public areas, e.g. going to work, navigating shopping centers, etc. Such activities are dependent on the functionality of different services, transportation opportunities, irrespective of if it is public and private. When people, in their role as

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customers (travelers in our context), use these services they have reasons to make demands on quality. When they experience (and contribute to) a travel processes, a fundamental quality dimension is usability, a concept that could be said to include other quality dimensions such as reliability, tangibility, accessibility, security, promptness, etc. That is, all services and its environment shall ideally be designed to be user-friendly without discriminating any customer segment. It is imperative with such an approach that transport services shall be usable (simple and intuitive) by all people to the greatest extent possible, without special adaptations. The usability concept is based on customer needs. Usability also integrates the issue of perception (user experience) along with the issue of interaction (user activities). During service production user perceive a wide range of process dimensions (own process, other customers processes, personnel processes, technology processes etc) and a myriad of other environmental and institutional cues communicating and constituting they transport service process.

When investigating usability of transport services we need to consider that usability is a function of a wide range of factors. Both research on dynamic service processes along with research on service environments struggles with the issue of interactivity. How can we empirically collect, validate and explain such fuzzy phenomena's were the interactivity of actors, actions, organisations and technology constantly change the object of study? This paper aims at a somewhat new understanding of how to approach such "fuzzy" phenomena in travel processes, from a usability perspective.

In the following section we describe central concepts in the existing literature identifying the present understanding of customer usability, followed by a discussion on the practical, theoretical and methodological side of research on dynamic services. New directions for research is proposed and used in an investigation of a quite mundane service process—a travel chain in public transport—with a somewhat alternative methodological approach. Empirically derived factors that hinder vis-à-vis supports the travelers 'navigation' in the transportation system are identified. Implications for research are discussed, especially issues of service environments.

The aim of the present study is to reach an in-depth understanding of travel processes—aspects we normally oversee due to methodological difficulties. Specifically, the study focuses on how individuals use service environments. The analysis is based on a travel chains perspective which means that different part of elements (modes, stops, transit halls, etc.) are studied as a whole (chain). The study assesses customers' experiences in natural settings with a qualitative open approach.

2 Literature review

Established theories and concepts have made a valuable contribution to the field of service environments—the physical settings and the impact on *the* customer. However, the literature review point out some paradigmatic links to individualistic and perception based research approaches. This is a problem, for research as well as for practioners. In the following we first discuss this and then the implications for methodological developments.

2.1 Existing literature

In the literature, a service has been defined as something that becomes 'real' when a customer interacts with some specific service prerequisites—such as organisational structures, activities, people, and other customers (Lovelock *et al*, 1996). This can be referred to as a 'service-system approach'. Because a service becomes 'real' during personal interaction, it is not easy for the customer to obtain a clear understanding of what he or she will receive until the actual interaction takes place. During this interaction, there are many factors that affect the customer's experience. The service interaction is surrounded by physical and communicative elements that provide information on the nature of the service and clues to its quality.

Research specifically interested in the physical environment investigates dimensions such as space, signs, symbols, artefacts and different ambient conditions. In focus is the holistic customer perception of these dimensions and its links to internal responses and individual behaviour. The basic idea is that elements of a firm's environment can be used to establish or reinforce an image and have impact on customer perceptions and level of satisfaction (see early references such as Booms & Bitner, 1982; Bitner, 1992). Moreover, situational factors are shown to have an effect on customers' perceptions, and hence on their behaviour (Grace & O'Cass, 2004). More recent consumer-behaviour theory elaborate on social elements (Peter *et al.*, 1999) such as culture, subculture, social class, social psychology, social interaction, etc). According to environment oriented pave of research, these factors create internal responses and might have a substantial effect on customer satisfaction.

Wakefield & Blodgett (1994) observed that the service environment assumes greater importance when a service is time-consuming and when a service is associated with pleasure activities. In coming to this conclusion, they distinguished between functional services and experience-based services. Moreover, in their study of leisure services (Wakefield & Blodgett, 1996), they identified five factors as having a major effect on quality perceptions: (i) accessibility; (ii) aesthetics; (iii) sitting comfort; (iv) electronic equipment; and (v) cleanliness. Factors such as these are certainly relevant in certain service settings, but they are too general to be of assistance in usability assessments and for a profound understanding of dynamic and time-consuming service processes. Moreover, the factors "accessibility" and "sitting comfort" are the only concept linking user to environment. In a study of airport departure lounges Rowley & Slack (1999) identify myriads of features in this environment that constitute the landscape of service and the "transient community" of the travellers. In addition to mere functional dimension of the environment, the ambient experience conveys cultural meanings that constitute every day activities.

Rafaeli & Vilnai-Yavetz (2004a) proposes three separate and concurrent dimensions—instrumentality, aesthetics, and symbolism—as integral to user perceptions in a study of public transport vehicles. *Instrumentality* is suggested in analyses of usability and human factor engineering (Garling & Golledge, 1989; Nielsen, 1994) and evaluations of physical places according to goal attainment (Canter, 1997; Howell, 1994). *Aesthetics* is suggested by research of space and environmental design (Nasar, 1997) and environmental psychology (Bateson, 1995). *Symbolism* presumes people as observers and interpreters of the physical environment rather than only active participants in this environment (Heft, 1997; Vilnai-Yavetz, Rafaeli & Schneider Yaacov, 2004). Even simple chairs, benches and tables, have symbolic meanings. A bench that may be functional or dysfunctional may or may not symbolize public, depending on the associations it trigger (Rafaeli & Worline, 2000). Thiel (1997) conclude that the knowledge of all elements of a physical environment contributes to a fuller understanding of user needs and thus to a greater social significance, given the potential to create better design of the built environment as a whole.

Aubert-Gamet (1997) argue that even though mainstream research has made a valuable contribution to the investigation of service places, and the role of physical settings on the customers' behaviours and attitudes, it has failed to take into consideration the process of social construction of the space by the customer, solely and in interaction with others. The larger body of research underlie the built environment as given, bounded and well-defined. This idea introduces an alternative perspective on the study of service environments. In her review of the field she claim that mainstream research (i.e. environmental psychology) fail to take into consideration the process of construction of the space by the customer.

The discussion of Aubert-Gamet (1997) has relevance to more time-consuming service processes such as public transport in that travellers of various kinds need to use the transport system, which could include different modes of transport during a single trip. A lack of trust in a transport system can be a significant problem, for frequent users as well as non-frequent users. For travellers, it is important that they can have trust in each specific link of the travel chain. If one link is missing the whole trip could be an unsatisfactory experience. Participating in everyday activities is an important determinant of health and well being and the opportunities to participate in societal life should be equal for all people (UN, 1993). Having a handicap or a functional disorder should not be a hindrance.

In traffic planning, the expression “the entire travel chain” has been introduced to emphasise the scope of a trip (Rikstrafiken *et al.*, 2003). Travelling from ‘door to door’ in a multimodal transport system is not an easy task—especially at the nodes between different transport modes where travellers can experience problems in navigating the system. The customer is supposed to interact with a system of service processes and due to the nature of this system need to handle part of the system independently. This co-participation in the service process is central for public transport services and makes issues such as reliability, usability and simplicity crucial.

These problems are exacerbated for disabled people with various handicaps. Existing research on environmental barriers in public transport has shown that travellers with functional disorders often perceive problems with service quality in this regard (Iwarsson & Ståhl, 1999; Lavery *et al.*, 1996). If a trip on the transportation service is perceived to be a ‘high-risk’ project, some will not even consider using the system. This is a challenge to service developers and calls for a profound understanding of what really happens ‘out there’. Existing research on travel chains is scarce, when it comes to travellers with functional limitations. An exception is Carlsson (2002) that in a focus group based study report on general usability problems linked to benches and seats, long distances and irregular walking surface, high kerbs, bad design of information at bus stops, level differences at entrances as well as inside buses, and narrow space in front of the seats. Five categories of environmental barriers could be identified, viz. the absence (1) or presence (2) of environmental detail, the design of an environmental detail in itself (3) as well as in relation to other environmental details (4), and the change of environmental demands from time to time (5). The study also revealed gap between usability problems observed by a professional occupational therapist and problems reported by the participants/travellers.

However, to date only a few studies are found addressing process matters and they are mainly concerned with separate parts of travel chains (vehicles, bus stops, sidewalks, kerbstone, tactile surfaces etc). No research is found studying the nodes between subsystems such as transit halls, information technology and other intermodal links. Further, no studies are found including customer perceptions of public transport processes or including holistic travel chains.

2.2 Needs for developments in practice and theory

For decades researchers have perceived service as being something different from products. The dynamic, interactive, and somewhat fuzzy nature of the service concept has been stressed, and it is apparent that the process and interactive nature of services is difficult to investigate, measure, and analyse. Indeed, Gummesson (1996) questioned whether the concepts, categories, models, theories, statistical data, and statements provided by research really capture reality. The bulk of research relies on perceptions as the ultimate determinants of service quality—rather than behavioural data. This makes for a shallow empirical foundation that depends on data from memory-based cognition and emotions. Moreover, the research often has a limited view of the service phenomenon—lacking sufficient recognition of the environmental, processual and interactive aspects of behaviour.

These problems have not always been addressed and discussed in mainstream research (Menor *et al.*, 2002; Thomke, 2003; Vargo & Lusch, 2004a), although the problems are often alluded to when questions are raised about data-collection methodology. The question of *when* to collect data—before, during, or after the customer’s experience—is especially relevant when assessing customer perceptions of the service experience. The question of *what* to collect involves an assessment of the relevant factors and social mechanisms to explore. The question of *how* to collect empirical data involves assessments of methods that provide a realistic representation of what really happens ‘out there’. Shortcomings at the level of data collection also raise questions about the results of advanced techniques of data analysis, and therefore about the overall validity of conclusions concerning service quality (Dahlsten, 2003; Matthing, 2004). Data collection clearly has implications for the development of theory and for the practical insights it provides. Research on user involvement (Alam, 2002; Magnusson *et al.*, 2003) has focused on some of

these critical empirical and methodological issues affecting the foundation of existing research. Research traditionally is based on retrospection which limits data to what could be stored in memory. Capturing customer data in natural settings *during* service experiences renders alternative conclusions, important factors for the user in the specific interaction. Other results might be obtained from studies based on: (i) behavioural data; (ii) alternative methods of data collection; or (iii) alternative forms of data analysis. The results of research using such alternative approaches might have implications for future theory development.

From the above discussion, it is apparent that mainstream methods for data collection (surveys and personal interviews) lack validity when it comes to assessment of certain aspects of service processes. Traditional surveys have fixed and *à priori* concepts and they therefore lack flexibility in collecting relevant data on the subjective personal experience of service processes. There will always be a substantial gap between the collected data and the experience of what actually happened in the real situation. Personal interviews are closer to the phenomenon and provide a better indication of the subjective experience of customers. Moreover, the verbal exchange between the respondent and the interviewer can attempt to manage the retrospective problems of a complex experience. However, this kind of data remains retrospective by its very nature, and the collected data always represent an experience of a *past situation*—with the possibility of error as it comes to memory during an interview. Retrospective methods, by their very nature, make it difficult to identify what *really* had an effect on customer perception.

For these reasons, various authors have pointed out that researchers need to go beyond retrospective psychological perception as the ultimate resource for obtaining data on customer perceptions of quality (Silverman, 1993; Den Haring, 1997; Heath, 1997; Echeverri, 2002). To overcome validity problems, researchers need to develop different kinds of observational methods to get closer to the phenomenon under study. For example, researchers could participate in real situations—taking field notes and documenting environmental details by the use of cameras. The present study therefore argues that there is need for approaches that are capable of collecting naturally occurring data during the actual experience. This kind of data is the best representation of what people *really* perceive using services and a potential platform for practical implications and developments that promote efficiency in all regards.

3 Design and methodology

The study *design* is based on a qualitative approach, searching for critical factors in the travel process. The methodological procedure follows the grounded theory approach of constant comparison of travel elements in the search for theoretical implications. The research was designed as follows, due to the aim of having rich *non à priori* descriptions and to facilitate the gathering and interpretation of process data (Echeverri, 2005).

Two samples of travel processes were analysed. The first sample consisted of individuals with different functional disorders such as (i) complete loss of sight; (ii) complete loss of sight with hearing aid; (iii) severe visual impairment; (iv) inability to use lower extremities (wheelchair user); (v) reliance of walking aid ('rollator'); (vi) complete loss of hearing; (vii) a parent with a child in a baby carriage; and (viii) cognitive limitations). The second sample consisted of people without any functional limitations. Individuals from both groups were to complete a 'well-known' travel chain and an 'unknown' travel chain, ending up in a 2x2 matrix.

The travellers were equipped with a mobile microphone to report on critical issues during the trip. They did this during a trip from their homes to a chosen destination. During the trip, a second person (a researcher) used a mobile video camera. This person followed the traveller to document the physical and communication environment. The travellers were instructed to contribute by a 'think-aloud' methodology—a psychological method for documenting spontaneous perceptions of the travel experience. This data collecting procedure was used, partly in order to encourage the respondents to

associate beyond the most obvious issues, such as problems and negative critical incidents, and report on things at a *non á priori* basis.

The gathered data consisted of video recordings of 1-2 hours for each of the travellers. Although, the majority of the recordings were of limited value—especially those when the traveller was merely sitting in a transport mode waiting for to be transported—many sequences were of greater value for the research purpose. These included recordings of the traveller leaving one mode, passing (say) a transit hall, and then continuing by another transport mode. In the videos, we were able to identify the travellers' mobility, behaviour, and gestures—as well as the various physical objects that formed elements of the process. The empirical material show how the 'respondents' (or informants) points, ask, touch, and smell different aspects of the environment. If something in the service environment was of significance, the respondent was able to comment on it using the mobile microphone. This data approach guided the analysis of what is important for the traveller and how to interpret its influence and meaning. This approach enabled a more profound understanding of the contextual setting by having the respondent point out important aspects and provides his or her interpretation of it.

Following this *in situ* approach, based on open coding of data, the investigation uncovered factors that are relevant for the travellers. In that sense, they are utilized to sort out critical issues and ease our understanding of how to interpret their experience. Usability was used as a sensitising concept to guide the analysis, because this concept includes functional capacity, environmental demands and customer activity (Carlsson, 2002). Because the data collection was close to the actual perceptions of the travellers, it can be argued that the methodology had high face validity.

This methodological approach should be seen in the light of traditional methods. To date, the primary source of information (data collection) about travel processes has been self-reporting (Gitlin, 1999; Steinfeld & Danford, 1999) and questionnaires or structured checklists focusing environmental components alone (Lavery & Knox, 1998). Given the definition of usability in travel processes such methods are of limited value. By definition, they lack information on the personal component. It is difficult for the user to assess usability without taking into account the activities that will be performed in the transport system. Other techniques have been focus groups, structured interviews, and informal discussions (McKenna & Lavery, 1998). For our purpose information is required about individual capacity, traveller activities and environmental factors. But valid and reliable methods for producing such information are scarce (Cooper et al, 2001). Usability problems are seldom assessed in a travel chain perspective. Only a few studies focusing on usability in the entire travel chain have been found (Jensen, Iwarsson & Ståhl, 2002; Carlsson, 2002) and none includes different kinds of vehicles during a door to door trip. All studies are more or less based on a limited amount of *predefined* categories for data coding, with negative implications on validity. More elaborate methods should include context specific information regarding aspects before, during, and after the trip, as well as aspects linked to use of equipment, time, security, and employee conduct. For an overview of methodological issues and problems, see Carlsson (2002) who conclude that dynamic environmental variations in public transport make accessibility assessment substantially complex (time of year, time of day, weather conditions, variations due to bus drivers, etc.). Research on customer perceptions during public transport need more open approaches and information from travellers in *real time*.

4 Results

The study documented 36 trips (16 with functional limitations, 20 without functional limitations). Respondents commented on their previous travel experiences, as well as their present experience. Among the issues frequently reported some were considered to be more problematic, important and overarching. In particular, respondents reported on their problems in managing nodes between different transport modes (transit areas, walking passages, layout, and so on). The final link (from final transport mode, via

transit halls, and further on to the final destination) was especially problematic. Electronic information systems were not always working, and some of them were difficult to use. It is apparent that the outcome of the service process is dependent on the links between its parts.

The study reveals that a wide range of services are crucial for the customer. For example, infrequent and disabled customers need to handle various aspects of an information system, such as ordering and using the telephone or Internet services; managing personal interaction and talking to service persons before, during, and after the trip; and using equipment, elevators, and so on. Handling automatic self service telephone 'menus' (to obtain special help during or before the actual trip) was difficult (even for frequent travellers). The overcrowded and noisy environment made it more difficult for respondents to hear what the automated voices were saying. Some new services (such as turning on footlights for the subway and using the telephone service) suffered from malfunction. In addition, there was a lack of informative signs and tactile references in the physical layout. The information placed at the travellers' disposal (signs, timetables, and so on) was not always helpful in supporting the process dimension of the trip.

At a customer level, it was obvious that physical attributes, spatial factors, self-service machines, guiding sounds, communication signs (or lack thereof), and transport noise are important cues. If these are inappropriate, the travel process is perceived as difficult, less accessible, and somewhat insecure. Because of these problems, travellers with functional limitations hesitate to use public transport—with resulting social segregation and high community cost. Able-bodied travellers, especially in the 'infrequent traveller' group, showed similar perceptions. People who are not used to the environment find it difficult to navigate the transit environment.

Whilst the option for the travellers is to stop at time schedules or line system maps, the moving walkways, escalators, footbridges, pavements and the endless subways that stretch down the length of transit areas convey the message to travellers that they are expected to keep going. This high load environment (noise, odour, rush and tear) with a minimum of verbal interaction (however overcrowded) exhibits a sense of urgency and activity. This has implications for design and content of schedules, maps, signs and symbols. Such elements need to be simple, easy to understand and give hands on information of how to navigate in the system. The design of communicative elements in transit areas need to take the process dimension and the spatial position into consideration.

Disabled travellers reported a sense of being stigmatised (Preiser & Ostroff, 2001) and there is a need for information that is designed with a practical view to optimising the flow of travellers. Customers are in constant motion and need reference points to direct their moves to their chosen destination. The study identifies cues that have not been reported in other accessibility studies and the findings point to potential areas for theory development. For example, the process aspect of signs and lay-out has not been reported elsewhere.

Using public transport is associated with specific values and norms (which are not always positive). For those who normally use private vehicles, public transport is partly perceived as something 'necessary evil'. In contrast, for disabled individuals public transport is associated with social well-being and quality of life. For these, the individual ability to access public transport is associated with having a 'normal' life.

A final methodological remark is the fact that the traveller being observed and the observer (researcher) do not always perceive the same aspects in the travel environment. Reported and observed usability problems to some degree elucidate different parts of usability. This gives argument for the non *à priori* research approach.

5 Implications

New methods of data collection, data analysis, and the empirical results they provide, raise questions about existing theory on services. Some findings from the present indicate that respondents report on

unexpected issues when confronted with the actual real-time service experience. Such issues, cues, and factors can form a new ground for theory development and more profound understanding of what really matters during service process and in interaction with servicescapes. The theoretical implication is that more in-depth studies are needed in future research.

There is a need for a change in the perception of what constitutes ‘quality’ in public transport. More emphasis should be placed on customer experiences than on specific features of the actual service. Service processes need to be developed more from a customer perspective if management wishes to create a more accessible and non-discriminating transport system.

It is apparent that the servicescape in public transportation needs to be organised in a way that facilitates customer mobility for all customers. What is easy and logical for able-bodied and frequent travellers is not necessarily easy and logical for disabled and infrequent travellers. Environmental designers could benefit from using this type of data on customer behaviour—paying particular attention to the communication environment from a processual perspective. Marketing personnel could provide more accurate information to travellers during, before, and after trips.

Armed with a more profound knowledge of customers’ real-time perceptions, service operators would be better placed to design effective services. This, in turn, could have a substantial impact in inducing customers to switch from costly road-based special transport vehicles (such as various kinds of taxis for disabled customers) to public transport.

Customers’ real-time perceptions could be an alternative starting-point for service design—especially in integrating various responsible organisations. In the case of public transport there are many actors—including the operators of various transport modes (bus, train, and tram), the various community authorities, different regional authorities, and various customer representatives. All of these parties could use this kind of concrete visual information as a platform for a more profound dialogue that promotes a long-term, accessible, and sustainable service system.

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