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From Vision to Transition

Exploring the Potential for Public Information Services to Facilitate Sustainable Urban Transport

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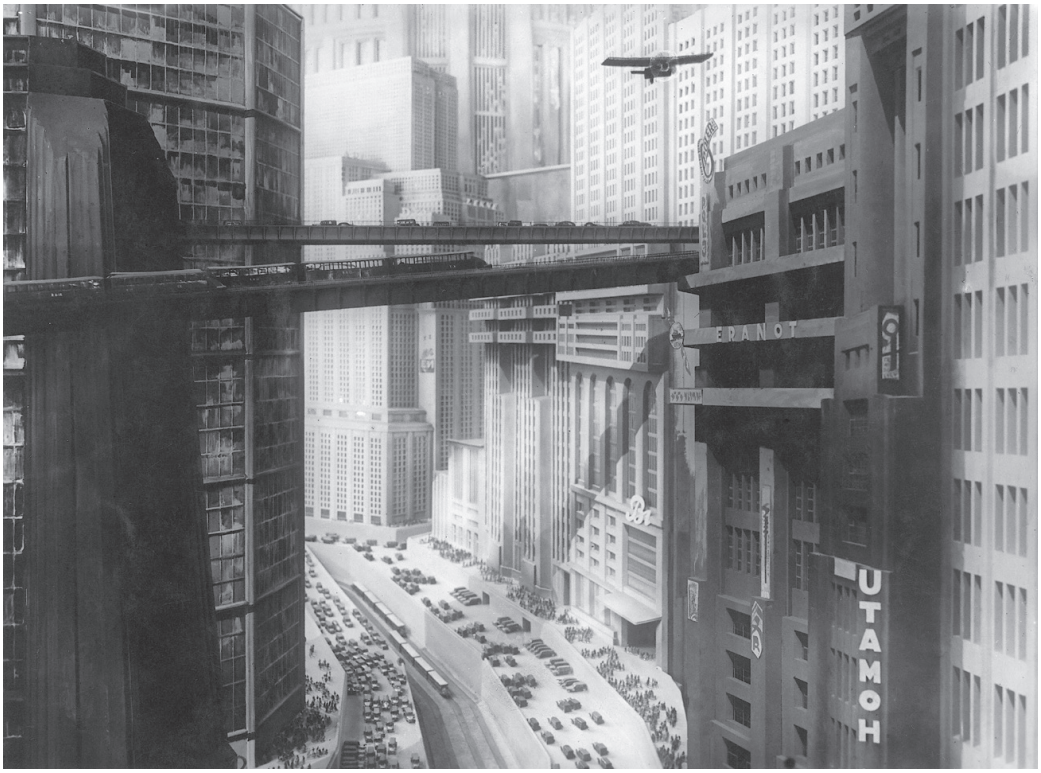

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Abstract

Background: Policy initiatives to promote sustainable travel through the use of Internet based public information systems have increased during the last decade. Stockholm, in being one of the first cities in Europe to implement an Internet based service for facilitating sustainable travel is believed to be a good candidate for an analysis of key issues for developing sustainable travel planning services to the public.

Aim: This thesis investigates the past development of two Stockholm based public information systems and their services in order to draw lessons on how to better provide for a public information service geared towards facilitating environmentally sustainable travel planning through information and communications technology. The overall goal of the thesis is to contribute to an understanding on how to better design and manage current and future attempts at facilitating sustainable travel planning services based on historical case studies.

Approach: The thesis draws ideas from the concept of organizational responsiveness – an organization's ability to listen, understand and respond to demands put to it by its internal and external stakeholders – in order to depict how well or not the two public information systems and their owners have adapted to established norms and values of their surroundings.

Results: Overall, the findings from the historical case studies suggest that organizations attempting to provide sustainable travel planning to the public need to design and manage their systems in such a way that it responds to shifting demands on how to provide for information. Implementing and embedding new technologies involves complex processes of change both at the micro level – for users and practitioners of the service – and at the meso level for the involved public service organizations themselves. This condition requires a contextualist framework to analyze and understand organizational, contextual and cultural issues involved in the adoption of new technologies and procedures.

Conclusions: The thesis concludes with a discussion on how the findings from the historical case studies may provide lessons for both current and future attempts at providing public information systems geared towards facilitating environmentally sustainable travel planning to the public. Historical examples and issues concerning collective intelligence and peer to peer based forms of designing, producing and supervising public information services identified throughout the study are looked upon and discussed in terms of their possible role in increasing the potential for public information services to facilitate sustainable urban transport.

Keywords: Collective intelligence; Peer to peer based production; Social media networking; Public information systems; Information and communication technology (ICT); Organizational responsiveness; Historical analysis; History of technology; Sustainable urban transport

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Sammanfattning

Förutsättningarna för att hantera efterfrågan på transporter genom att tillhandahålla reserelaterad information förändras kontinuerligt. Flexibilitet med avseende på information, prissättning och transportmedel samt mångfald av valmöjligheter ställer stora krav på både infrastruktur och aktörers möjligheter till informationshantering. En utveckling mot ett mer hållbart transportsystem kräver medel för att göra det mer attraktivt att gå, cykla eller resa med kollektivtrafik och mindre attraktivt att använda bilen.

Ett sätt som förespråkas i allt större utsträckning i takt med teknikutvecklingen är att tillhandahålla informationsbaserade tjänster via populära medier såsom websidor och appar. Dessa medier kännetecknas av ett stort beroende av Internetuppkoppling samt ett allt större krav på snabbtillgängliga och dynamiska interaktionsmöjligheter. Allt mer användarcentrerade reseinformationstjänster men framförallt allmännyttiga tjänster berörs av ett sådant institutionellt läge. En lösning som alltmer eftersträvas är att med hjälp av personaliserade informationstjänster underlätta för ett mer hållbart vardagsresande. Med hjälp av uppkopplade resenärer och en ny form av digital infrastruktur där nya öppnare tjänster samskapas med resenärer finns förhoppningar om att öka möjligheterna till ett mer hållbart utnyttjande av transportsystemet.

Syftet med detta avhandlingsarbete är att undersöka förutsättningar för allmänna informationstjänster att med hjälp av kommunikationstekniker av skilda slag åstadkomma effektivisering och samordning i stadstrafiken i förhållande till en miljömedveten trafikplanering. Fallstudier görs av två olika projekt från det nära förflutna som syftat till att effektivisera och samordna stadstrafiken med hjälp av riktad information med hjälp av olika kommunikationstekniker. Projekten är i första hand Stockholmsbaserade, bestående av två allmänna informationstjänster. Förutsättningar undersöks på två olika plan: dels funktionellt/organisatoriskt utifrån hur bakomliggande organisationer anpassat sina tjänster i förhållande till skiftande krav från allmänheten och utifrån stadsutvecklingen i fråga om reserelaterad information; samt utifrån idéer samt visioner kring möjligheten att förändra individers resmönster med hjälp av informationsteknologi.

En viktig framgångsfaktor som åskådliggörs i avhandlingsarbetet är förmågan att snabbt anpassa tjänsten till de förändringar som sker i omgivningen i fråga om hur användare införskaffar samt delar med sig av information. Ovanstående möjligheter visar på hur de krav som ställs på allmänna informationssystem och deras tjänster växlar med tiden vilket kräver ett större blickomfång i fråga om möjliga framgångsfaktorer och problemområden. Organisatoriska såväl som politiska och socioekonomiska faktorer som kan tänkas påverka allmänna informationssystem och tjänster har åskådliggjorts i avhandlingen utifrån historiska fallstudier av allmänna informationssystem sedan slutet av 1970 talet. Exempel och frågor som berör kollektiv intelligens samt peer-to-peer baserade sätt att organisera, producera samt övervaka offentliga informationstjänster diskuteras i termer av individers och organisationers relation till teknik och informationsbehov och dess möjliga betydelse för ett mer hållbart transportsystem.

List of appended papers

This thesis is based on the work presented in the following papers:

Paper I
Cano Viktorsson, Carlos (2013). Traffic Radio as a Precursor to Smart Travel Planning Systems: The Challenge of Organizing "Collective Intelligence". Published in the *Journal of Urban Technology* 20:4, pp.43-55, London, UK: Routledge.

Paper II
Cano Viktorsson, Carlos (2013). From Maps to Apps: Using History to Inform the Design and Management of a Multimodal Travel Planner. Submitted to *Transportation Research Part A: Policy and Practice*.

Preface

This thesis that you are holding in your hands – and that you hopefully will read from cover to cover – could in a sense be seen as an account of the social life of two sociotechnical systems. Besides describing the political underpinnings, visions and technologies making up for two distinct yet similar IT based services being studied within it the study also contains the accounts of several individuals who experienced much of what I would call a process of *ethos* making. The reason I bring up ethos this early on is because it has importance for how I have framed this whole study. Ethos can be seen as the guiding beliefs or ideals that characterize the disposition of an individual or a group – which in this case has concerned not only how organizations have attempted to design, produce and monitor public information services according to a certain goal but also throughout their direct involvement with a culture of managing information through media technology. Media technologies are important to acknowledge in studies of information systems since they are increasingly employed for sense making and orientation throughout our daily undertakings. I believe ethos is involved in how and why one form or another of technology is selected over another since reasons for making use of a certain form of technology is at most times not random. The question of ethos raises important questions as to how expertise and the role of technology act as vehicles for attempts at modernization and increasingly nowadays in terms of an "ecological modernization". Ecological modernization can be viewed as an industry centered "green" *method* in which industry and economic growth continue being viewed as important means for modernization, in which sustainable development is a key goal. This thesis directs attention instead to what necessary *shifts* or transitions are needed in order to achieve a more sustainable urban transportation. The thesis has focused on depicting possible mechanism for mobilization that may be found in how individuals and organizations have made use of technology and not solely on the technology itself. Much of what is depicted throughout this study are enactments of a certain set of beliefs not only by certain individuals but also in dialogue with a larger body of knowledge understood here as actor-networks.

The sharing of readily available and open data together with collaborative practices based on real-time interaction have become guiding words for how services are expected to be provided for. Internet instead of radio or television has become the main conduit for making the city sensible and aware within the notion of a smart sustainable city. Having everyone partake in the making of predominantly web based content and services, such as Facebook or Twitter, on a peer to peer based level have increasingly become viewed upon as a means for interconnecting the citizen with the governance of the urban environment. Keeping aside the commercial interests and at many times overly technologically optimistic rhetoric one could argue that these very same opportunities for displaying ones actions and choices through increasingly networkable information and communications technology have been available far earlier. The difference nowadays rest on scalability and in what some call

information richness, or media richness in the wake of increased media convergence and mobile connectivity. There is no doubt that we have reached a point in which the possibilities for us to interconnect our daily undertakings and choices in how we travel are unprecedented, but what is at stake – particularly so in terms of attempts at a sustainable transition towards sustainable urban transport is collective action at a sense making level, both individual and organizational. Modes of content production and consumption mentioned earlier such as through Facebook or Twitter need to be aligned with a potential to inform our awareness and sensibility with regard to the effects of one's actions on the environment. I believe the challenge now – as has been the challenge previously – is how to organize those shared or group intelligences that may emerge from the collaboration and need for socializing of many individuals in such a way that it may be harnessed towards such a specific task. Much of the research presented in this study has touched upon such a challenge which I hope will be reflected upon by you when you continue reading this thesis – cover to cover, I hope.

Acknowledgements

There are many who deserve to be thanked for the realization of this work. I would like to express my gratitude to my supervisors who have seen me through this period of Ph.D. studies. I would like to thank my main supervisor Prof. Anders Gullberg and my co-supervisors Prof. Arne Kaijser and Prof. Mattias Höjer for their readiness to give advice and support. I also want to thank Prof. Örjan Svane whose detailed review of my manuscripts and subsequent recommendations have proved invaluable during the shaping of this thesis. I also would like to thank Prof. Oskar Juhlin for reading my work and taking his time to be my opponent. A special thank you is directed to Prof. Richard E. Hanley, Editor-in-Chief of the Journal of Urban Technology, who led me through the process of publishing some of my first original research.

Among my fellow co-workers there are plenty of people at different places that I would like to thank. Victoria Pérez Belis (now in Spain), Daniel Vare, Mohammad Ahmadi Amachleiu (now in Switzerland), Yevgeniya Arushanyan, Malin Picha Edwardsson and Shakila Umair at CESC have all been great listeners while being extremely supportive. Eric Paglia, Adam Netzén, David Nilsson together with Prof. Sabine Höhler at the Division of History of Science, Technology and Environment have all been very kind and encouraging. I also want to thank everyone at the Division of History of Science, Technology and Environment together with the Division of Environmental Strategies Research (fms) for being so open and generous to me while at their divisions.

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¡Mil gracias y cuidense muchísimo!

Thank you all!

– Carlos Cano Viktorsson

Stockholm on the 28th of February, 2014

There can be no understanding between the hand
and the brain unless the heart acts as mediator

– Maria, *Metropolis (1927)*

1 Introduction

Why a study on the potentials for facilitating sustainable travel through Information and communications technology (ICT) and why look at previous examples of providing traffic and travel related information – and in Stockholm, Sweden of all places? Part of the reason can be found amongst our own belongings, namely the mobile phone or smart device that we increasingly make use of for many of our daily undertakings. It is no overstatement that mobile handsets have become more numerous and that their capabilities have evolved. They have not done so without a change in the infrastructure, with faster networks and increased investments in providing for their needs. Mobile subscribers now outnumber fixed-wired subscriber's which has increased the potentials for in situ, en-route and dynamic information gathering, processing and dissemination. These same factors of increased mobility and accessibility to information are having immense socio-economic effects on our daily undertakings. It is a condition that prompts for a closer look at the potential for public information services to make use of ICT for attempts at facilitating more environmentally sustainable travel and urban transport.

The development of transport services for both passengers and goods have in the history of their development both affected and been affected by an essential need for individuals' and organizations to connect with one another, by gaining access to work, education, friends and family, goods and services among other things. This need for connecting and gaining access has in large part been satisfied through our means of communicating with one another. Changes in communication technologies have evolved in tandem with shifts in political and economic systems, and by extension, systems of power.[1] Transportation is no exception and with the last decade's introduction of highly advanced and mass produced mobile communication devices finding their way to individuals and organizations immense effects have taken place in the relationship between travel and telecommunications. This entails interactions involving everything from physical mobility, access, coordination and non-physical travel to consumption practices and social networking. According to the *International Telecommunication Union* "we live in an era where Information and Communication Technologies (ICTs) underpin almost every single activity undertaken in the modern world" in which ICT based networks and applications are increasingly managing "food distribution, power networks, water supplies or mass transportation".[2] As such, sustainable transport through tools for telecommunication such as ICT has become an interrelated theme placed high on the policy agenda of governments worldwide.[3] Solutions

[1] Harold Adams Innis, *The Bias of Communication* (University of Toronto Press, 1991).
[2] http://www.itu.int/en/pages/default.aspx*World Telecommunication/ICT Development Report 2010*, p.iii
[3] John Black, Chloe Mason, and Kristine Stanley, "Travel Demand Management: Policy Context and an Application by The University of New South Wales (UNSW) as a Large Trip Generator," *Transport Engineering in Australia* 5, no. 2 (1999).

involve measures to both monitor and manage the demand for travel through information or to redistribute this demand in space and/or in time.[4]

Traveler related information may in its broadest sense include timetables, road signs and maps but the focus has increasingly been on information communicated through smart traveler information systems utilizing highly networked and sophisticated technologies.[5] Traveler information systems may cover a single metropolitan area, an entire region or even a whole country and more so if necessary. These systems might use data from a single transportation entity, such as road traffic from a metropolitan road authority, or it might cover multiple modes of travel with data from several agencies and also private entities. Data within these systems and the infrastructure they make use of have both an intrinsic and external value when processed and provided for in forms that can be used to influence travelers' trip-making decisions in real-time.[6] Historically there has been since the late 1990s a growth in public sector transportation agencies incorporating traveler information capabilities into their public information systems throughout Europe and the United States.[7] While these steps where seen as novel at the time they had by no means been the first attempts at providing travel related public information systems through ICT. Previous examples include public radio broadcasts in the late 1930s reminding people of the potential holiday traffic congestion or the traffic reporting concerning local road conditions to motorists all throughout the late 1970s until the present. While previous measures may have been more modest in their intentions recent visions have increasingly become enamored with the promises of a 'smart' use of ICT. There are several definitions of the term *smart city* but the main focus seems to be on the role of ICT and how cities must or should use new technologies in order to transform their systems to optimize the use of finite resources and improve economic efficiency while achieving "political, social, cultural and urban development".[8] One may argue that the theme of the role of ICT for smart cities has become overly glorified. While flagship projects with advanced technology and streamlined business models are marketed to both public and private enterprises as best practices one important aspect is undermined – the role of collaboration. Authors such as Andrea DiMaio (2012) argue that what is at stake here becomes not the use of a certain form of technology but how

[4] Donna Nelson, ed., *Intelligent Transportation Primer* (DC: Institute of Transportation Engineers, 2000).
[5] U.S. Department of Transportation, Federal Highway Administration, *Managing Demand through Travel Information Services* (Washington, DC: U.S. Department of Transportation, Federal Highway Administration, 2005).
[6] Ibid.
[7] U.S. Department of Transportation Federal Highway Administration, *Real-Time Traveler Information Services Business Models: State of the Practice Review* (Washington, DC: U.S. Department of Transportation Federal Highway Administration, 2007).
[8] Arturo Haro De Rosario et al., *Are the Smart Cities the Most Democratic?: The Spanish Case* (Edinburgh, Scotland UK: 2013 EGPA Annual Conference, 2013), p.3.

different sectors (not just government) cooperate and how they exchange meaningful information in accordance to their own unique situations.[9]

Cities are increasingly demanding greater efficiency, quality of life, and sustainable development which translates into finding modes for improved resource management and service provision. Public authorities are looking to implement management models that hold a potential to respond to such a demand on the urban environment. As of now the main vehicle for such an implementation seems to be on focusing on the role of ICT and increasingly so within the idea of the *smart city*. The concept of "user-driven public services" is steadily gaining ground both for e-governance and public service provision, in which scenarios of highly personalized public services are envisioned. Implicit is a view that collaboration with all affected stakeholders plays an important role for addressing *wicked* problems, such as the problem of unsustainable development.[10] In response, public authorities as well as other stakeholders have begun to share information in order to drive innovation and provide user based services while seeking economies of scale. Rising expectations to find means of addressing increasingly complex multi-scale situations and user demands are increasingly putting pressure on public administrations to foster efficient, open and collaborative services.

Recognizing the potential for both reaching and in a sense make use of citizens as sources of information there are immense efforts at providing efficient e-based public information services to the general public. The expectation has been that information can lead to increased knowledge and changes in attitude which may result in environmentally positive behavioral changes.[11] The area of transportation management has already acknowledged that the way we as individuals travel has a major impact on our environment. While the technology for influencing travel behavior may exist one challenge will continue to persist – how to organize and operate such services so that users can get the relevant information at the right time and with the right effects. The increasing take up of ICT tools, such as social media networking technologies and innovations together with increased connectivity and networking capabilities are changing the relationship between the constituents of large sociotechnical systems, and most notably so between citizens and the public sector. One area of particular concern for public information services relates to increasing attempts at developing more open and participatory governance within a changing media landscape that increasingly conditions the means and processes for communication. Openness and

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[9] Adapted from Andrea DiMaio, "Technology Is Almost Irrelevant for Smart Cities To Succeed," 2012, http://blogs.gartner.com/andrea_dimaio/2012/08/10/technology-is-almost-irrelevant-for-smart-cities-to-succeed/.

[10] Jonathan Pryshlakivsky and Cory Searcy, "Sustainable Development as a Wicked Problem," in *Managing and Engineering in Complex Situations*, ed. Samuel F. Kovacic and Andres Sousa-Poza, Topics in Safety, Risk, Reliability and Quality 21 (Springer Netherlands, 2013), 109–128, http://link.springer.com/chapter/10.1007/978-94-007-5515-4_6.

[11] Tor Skoglund and I.C. MariAnne Karlsson, "Appreciated–but with a Fading Grace of Novelty! Traveller's Assessment Of, Usage of and Behavioural Change given Access to a Co-Modal Travel Planner," *Procedia - Social and Behavioral Sciences* 48 (2012): 932–940, doi:10.1016/j.sbspro.2012.06.1070.

collaborative technology tools are seen within such a setting as enabling a monitoring of the urban environment and its performance which is believed to hold a potential for enabling a sustainable urban transition. Sustainable urban transition implies finding other forms of production and processes related to urban development that are more sustainable. A shared idea is the need for a transformative change at the systems level, with regard to production and consumption, based on multi-level governance and more adaptive structures. Due to sustainability problems being inherently ambiguous and complex a transition from the traditional incremental modes of production and service provision will not suffice. Joan Clos (2013) in his introduction to the UN's latest Global report on sustainable mobility notes that:

> "it is essential that all stakeholders in urban transport – including all levels of government, transport providers and operators, the private sector, and civil society (including transport users) – are engaged in the governance and development of urban mobility systems." [12]

Although the technology may exist for such an undertaking the requirements go beyond the mere use of technology. There is a need for a multi-faceted perspective when discussing the complex issue of how sustainability-oriented urban transport infrastructures and services are planned, appraised, delivered and operated. This includes investigating institutional regulatory and policy drivers and barriers, economic valuation, technical innovation and consumption that are then applied both to the practices of businesses and corresponding government policy and law. Enacting sustainable transitions will need to include both a critical and explorative approach of both past and current developments in how to provide for information based services and how it may influence institutional and organizational frameworks for developing services. One such approach used in this thesis has involved the depiction of a particular *organizational responsiveness* as seen throughout the history of public information services attempting to manage travel through information. This involves depicting what actions have been taken by the owners of a service but also what forces and events have been in play at a certain moment in time that may have affected the outcome of the decision making and the service in question. Analysing past attempts at organizing travel related information services with regard to existing efforts to improve sustainability performance holds the potential for developing strategies on how to better co-ordinate such services based on past experiences and attempts at service provision.

Within the area of travel information services focus has shifted towards providing users with a set of multiple choice alternatives such as mode of travel, route selection, level of comfort, and time scheduling among other functions.[13] Flexibility has unquestionably become a key requirement for such kind of a service, in which system providers see themselves

[12] UN-HABITAT, *Planning and Design for Sustainable Urban Mobility – Global Report on Human Settlements 2013.* (UN-HABITAT: UN-HABITAT, 2013), p.vi.
[13] Anders Gullberg, "Stadstrafiken Är En Usel Tjänst - Så Löser vi Problemen!," in *Stockholm on the Move* (Stockholm, Sweden: Färgfabriken, 2012), 26.

increasingly dependent upon highly real time based and responsive uses of ICT for gathering, processing and disseminating necessary information. More recent developments towards the use of apps or applications running on mobile devices are increasingly being employed to provide for such a service level. The demands for such interactivity and subsequent scalability through a sharing and re-use of information are not new and have been provided for previously with the help of "old" technology.

While managing travel through information is not a new concept it is the level of involvement by a multitude of stakeholders equipped with advanced telecommunications means that are increasingly shaping the conditions for such a form of information based management. Information centered services are increasingly being shaped by the expectations of its surroundings. This includes amongst other things travelers' increasingly becoming equipped with advanced means of telecommunicating while en-route which presents not only new possibilities but also expectations on both services and their means of organizing a system for such a provision. More recent challenges concern how to provide information to travelers in several forms while keeping up with technological advances on how to provide for information. Although some research has suggested that travelers may be willing to pay for information if it is highly reliable and in real-time[14] there exists a level of service provision in countries striving towards implementing intelligent infrastructure that requires the information to be free and publicly available.[15]

A first and increasingly common approach to sustainable development has often been overly technology optimistic by focusing solely on finding a technological "fix" for solving the sustainability problem. A second, and less technology optimistic approach which has been made use of throughout this study has been to look at what possible models for organization are needed when designing adaptable and hence more sustainable uses of infrastructure that may better respond to changing demands from ones surrounding. This approach highlights the co-evolutionary development of a system and its services in tandem with consumer culture, media use, and technological trends. The approach emphasizes a need for looking at visions, behaviors and actions of people – and the technologies they employ –as influencing each other throughout a process of *translation*. Translation is seen here as a process involving the interactions and to some degree dialogue between different entities in which the stability of an enterprise – depicted as an actor-network – is not only influenced by distinct interpretations of a common goal or purpose but also by the relational ties and mutual dependency among its constituents (including non-humans) which may influence how they act towards each other and the network. This last part is highly influenced by Bruno Latour, Michael Callon and John Law's material-semiotic approach to social theory,

[14] Eric J.E. Molin and Harry J.P. Timmermans, "Traveler Expectations and Willingness-to-Pay for Web-Enabled Public Transport Information Services," *Transportation Research Part C: Emerging Technologies* 14, no. 2 (April 2006): 57–67, doi:10.1016/j.trc.2006.05.003.

[15] Andrea Caragliu, Chiara Del Bo, and Peter Nijkamp, "Smart Cities in Europe," *Journal of Urban Technology* 18, no. 2 (2011): 65–82, doi:10.1080/10630732.2011.601117.

called Actor-Network Theory (ANT). Important to keep in mind is that ANT is not a theory in itself but an approach. It does not seek to explain "why" things happen and focuses instead on telling stories about "how" relations may assemble or not and how they are *performed*.[16]

The main argument presented in this thesis is that the potential for having services organized in such a manner that they may hold a potential for facilitating sustainable travel cannot be understood without a holistic and multifaceted approach to their contextual dependency. This has included looking at the importance communications media and information systems have on an organizational level when providing traffic and travel related information and what institutional obstacles and potentials need to be looked at throughout the history and development of such attempts. How social practices surrounding the use of increasingly mobile interactive media are connected to institutional, economic and cultural factors that shape the form and use of such a technology are often left out in the policy makings and need to be considered when talking about a potential for making use of ICT for facilitating sustainable travel.[17] This has warranted the use of a 'community/institutional lens' when looking at their implementation in order to highlight how people participate with others in culturally organized activities when creating the value of a service.[18]

1.1 Research overview

A starting point for a review of the relevant literature is to look at travel-telecommunications conceptually. Starting with the term 'telecommunication' (tele-distance) we find that it was coined by the French novelist Edouard Estaunie´ in 1904 to describe the telegraph and telephone communications at the time.[19] The term has increasingly evolved to include different forms of telecommunications and technologies such as radio, television, mobile phones and the Internet. These media are forms of telecommunications because they allow their users to observe, listen and talk over distances.[20] The development of such media technologies has been plentiful and varied throughout history. These forms of telecommunication have increasingly become capable of providing point-to-point communications according to Gabriele Balbi (2009).[21] Balbi argues

[16] John Law, "Notes on the Theory of the Actor-Network: Ordering, Strategy, and Heterogeneity," *Systems Practice* 5, no. 4 (August 1, 1992): 379–393, doi:10.1007/BF01059830.
[17] Robin Williams and David Edge, "The Social Shaping of Technology," *Research Policy* 25, no. 6 (September 1996): 865–899, doi:10.1016/0048-7333(96)00885-2.
[18] Deborah Corrigan, Justin Dillon, and Richard F. Gunstone, *The Re-Emergence of Values in Science Education* (Sense Publishers, 2007), p.107.
[19] Anton A Huurdeman, *The Worldwide History of Telecommunications* (New York: J. Wiley, 2003).
[20] Gabriele Balbi, "Studying the Social History of Telecommunications," *Media History* 15, no. 1 (2009): 85–101, doi:10.1080/13688800802583331.
[21] Ibid.

that there has been a lack of interest in the social history of such forms of telecommunication by citing what Balbi calls one of the most influential books on the social impact of the telephone to portray the reason. Edited by Ithiel De Sola Pool at the end of the late 1970s the book argues that:

> Wherever we look, the telephone seems to have effects in diametrically opposite directions. . . . The telephone's inherently dual effects are one reason for the paucity of literature on its social impact. Its impacts are puzzling, evasive, and hard to pin down. No matter what hypothesis one begins with, reverse tendencies also appear.[22]

The dual effects De Sola Pool referred to involved for example the *expansion* and *compression* of distances, *improvement* and *restriction* of privacy, or the *intensification* and *reduction* of social contacts which contributed to a reluctance by researchers to tackle the issue.[23] This very same duality should instead be seen as an ideal condition for a scientific debate according to Balbi.[24]

According to Timo Kopomaa (2002) Scandinavia is at the forefront of a point-to-point development in having mobile communications penetrating deep into social and business networks.[25] Researchers such as Kevin de Souza et al (2012) finds that such a form of telecommunication provides societies with the capacity for "real-time situational awareness, smart decision-making, and sustainable deployment of public resources" within the idea of a smart infrastructure. [26] They identify technological designs with a potential for facilitating local solving but which need supportive policies and governance platforms put in place in order to have any substantial effect, most importantly in terms of open data. They identify such measures in efforts being made by governments to promote transparency by making their data available for public access through open data websites and forums. [27]

Sociologists such as John Urry et al (2006) see within these developments the potential for a new mobility paradigm taking place that may break us free from having to schedule necessary coordination, hence negating the need to plan anything.[28] Within such a paradigm "accessibility becomes more important than mobility".[29] Such a condition influences the

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[22] Ithiel de Sola Pool, *The Social Impact of the Telephone* (Boston MA: MIT Press, 1977), p.4.
[23] Balbi, "Studying the Social History of Telecommunications."
[24] Ibid.
[25] Timo Kopomaa, "Mobile Phones, Place-Centred Communication and Neo-Community," *Planning Theory & Practice* 3, no. 2 (2002): 241–245, doi:10.1080/14649350220150125.
[26] Kevin C. Desouza and Akshay Bhagwatwar, "Citizen Apps to Solve Complex Urban Problems," *Journal of Urban Technology* 19, no. 3 (2012):p 108.
[27] Ibid.
[28] Mimi Sheller and John Urry, "The New Mobilities Paradigm," *Environment and Planning A* 38, no. 2 (2006): 207 – 226, doi:10.1068/a37268.
[29] Anthony M. Townsend, "Life in the Real-Time City: Mobile Telephones and Urban Metabolism," *Journal of Urban Technology* 7, no. 2 (2000): p 96, doi:10.1080/713684114.

relationship between agency and structure and has prompted some researchers to argue that recent developments in telecommunication technologies need to be understood as ensnaring leisure time and spaces within the domain of consumption.[30] The use of publicly accessible Information and communication technology (ICT) fall into this predisposition in that it provides a consistent unified user interface and user experience across multiple devices and media types.[31] Unified communications involve both real-time and non-real-time delivery of communication. Chorus et al (2006) observe that having information services being increasingly envisaged as being able to provide "anytime" information –both asked and unasked for – within a multimodal network puts demands not only on the ICT being employed but on the institutional framework made use of by the service providers. Policymakers have high expectations on the potential effects of such information systems, most importantly in terms of network efficiency.[32] Expectations of network performance in terms of speed, throughput and reliability amongst others dominate the visions of their use and intended effects not only among telecommunication companies, transport agencies, governments and academia but in the public that make use of them. Paul N. Edwards (2003) observes that infrastructures have increasingly become understood as smooth working, 'natural' infrastructures in which access are taken for granted.[33]

Caragliu, Del Bo and Nijkamp following a review of the relevant literature on the topic of smart cities (2011) find that what characterizes a smart city is most commonly: 1.) The "utilization of networked infrastructure to improve economic and political efficiency" with connectivity as its source of development, 2.) An "underlying emphasis on business-led urban development" 3.) "A strong focus on the aim of achieving the social inclusion of various urban residents in public services", 4.) "A stress on the crucial role of high-tech and creative industries in long-run urban growth", 5.) "Profound attention to the role of social and relational capital in urban development", and 6.) "Social and environmental sustainability as a major strategic component of smart cities".[34] Mobile communications devices are increasingly woven into the daily life of cities constituting what researchers such as Anthony M. Townsend (2000) call a form of "life in the real time city" that needs further understanding.[35] The real-time city can be characterized by an increased interlinking of individual systems and functions based on telecommunications, into one overall system.

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[30] Richard Popp, "Machine-Age Communication: Media, Transportation, and Contact in the Interwar United States," *Technology and Culture* 52, no. 3 (2011): 459–484, doi:10.1353/tech.2011.0105.

[31] Ralph M. Stair and George W. Reynolds, *Fundamentals of Information Systems* (Boston: Cengage Learning, 2011), p.426.

[32] Caspar G. Chorus, Eric J. E. Molin, and Bert Van Wee, "Use and Effects of Advanced Traveller Information Services (ATIS): A Review of the Literature," *Transport Reviews* 26, no. 2 (2006): 127–149, doi:10.1080/01441640500333677.

[33] P.N. Edwards, "'Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems,,'" in *Modernity and Technology*, ed. P.B.a.A.F. Thomas J. Misa (Cambridge, Mass./London: The MIT Press, 2003), p 190.

[34] Caragliu, Del Bo, and Nijkamp, "Smart Cities in Europe."

[35] Townsend, "Life in the Real-Time City."

Attention is drawn towards the need to make more 'intelligent' use of the available systems' capacity, both for individuals and the system as a whole. A lack of adequate provision of information becomes a barrier to people's desire to make more fully informed choices according to transportation researchers such as Glenn Lyons. [36]

The institutional framework

While steps towards interlinking dispersed systems into one whole system may be viewed as a solution their level of successful implementation is highly dependent on adaptation, not only to current socioeconomic practices but also to political circumstances and visions, since a 'system' is composed not only by products and services but by groups and stakeholders that participate in defining it. In order to realize these visions different stakeholders will have to cooperate and in some cases be forced to do so according to Anders Gullberg (2012).[37] Gullberg adds that this will require specific circumstances and decision competencies. He mentions Ken Livingstone, who made congestion tolling possible in London in 2003 and Jaime Lerner who implemented the rapid bus transit system in Curitiba, Brazil in the early 1990s, as two examples of this. What Gullberg points out is that the introduction of any kind of systemic change in traffic, regardless for the better, will almost always become contested. David Banister, a transport researcher looking at possible paradigm shifts in transport argues in the same line as Gullberg in that public acceptability is essential for a successful implementation of radical change. Banister adds that it "must involve community and stakeholder commitment to the process of discussion, decision making, and implementation." [38] However, while there is abundant literature concerning communication technologies and their potential for promoting sustainable travel in terms of its effects and technological requirements there is a need to link their use to the wider context particularly with regard to institutions. Historical analysis of science and technology provides great insights into how these expectations on telecommunications within a smart city have come about and how ICT based services have been viewed throughout time in terms of enabling a certain form of agency.

According to Joseph M. Sussman we are "dealing within an increasingly institutional framework composed by new kinds of relationships between and among the public and private sectors reshaping the way we deploy transportation systems".[39] This includes looking at the requirements of the service and how actors that comprise the service fulfill these requirements. The last decade has seen increasing work investigating 'co-evolutionary'

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[36] G. Lyons et al., "Assessing the Demand for Travel Information: Do We Really Want to Know?," Conference or Workshop Item, October 2008, http://www.etcproceedings.org/.
[37] Gullberg, "Stadstrafiken Är En Usel Tjänst - Så Löser vi Problemen!".
[38] David Banister, "Is Paradigm Shift Too Difficult in U.K. Transport?," *Journal of Urban Technology* 14, no. 2 (2007): p 76, doi:10.1080/10630730701531732.
[39] Joseph M. Sussman, *Perspectives on Intelligent Transportation Systems (Its)* (Springer, 2005), p.91.

approaches to understanding technological change in which "the development of technologies both influences and is influenced by the social economic and cultural setting in which they develop".[40] A great amount of research stressing the complexity in the relationship between technological artifacts and the society can be seen in the field of Science and Technology Studies (STS). From STS follows that solutions to the sustainability problem is not a technical one alone and can as such only be instrumental in being "embedded in organizations or institutional frameworks or in structures of governance".[41] The dangers pertain to a falling back on technological determinism by reducing complexity into "a unidirectional view of "effects" or "impacts" of a "given" technology on society."[42] The complex issue of a modern cities' 'metabolism' – its use, transformation, and discarding of resources – is seen by some authors as "shaped by the nature of its society and its involvement in the world economy". Their metabolism becomes important to acknowledge since cities understood as urban settlements consumed 70-80 percent of all resources at a global scale already in 1997 according to Peter Baccini, and unless these settlements become sustainable global goals will never be met.[43]

From policy to practice

Acknowledging that transport policies alone are not enough to manage increased demands for mobility in terms of transportation authors such as David Banister and Dominic Stead (2004) argue that measures to achieve a more sustainable transport requires a combination of both transport policies and non-transport policies that take in account technology.[44] The authors mention real-time traveler information systems as having the potential to significantly affect mobility patterns. Such information systems, that can give advice on how to travel, public transport connections, parking, congestion, waiting times, can according to the authors "ensure a more efficient use of existing infrastructure and vehicle use" where the information "can influence the behavior of transport users" [45]. Banister et al. (2000) find the role of information applicable to lifestyles and attitudes in that information based measures have the potential of changing attitudes towards environmentally friendly motives.[46] This requires changing the organization of the transport market as a whole,

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[40] Townsend, "Life in the Real-Time City."
[41] Jacques J. Berleur, Magda David Hercheui, and Lorenz M. Hilty, *What Kind of Information Society? Governance, Virtuality, Surveillance, Sustainability, Resilience: 9th IFIP TC 9 International Conference, HCC9 2010 and 1st IFIP TC 11 International Conference, CIP 2010, Held as Part of WCC 2010, Brisbane, Australia, September 20-23, 2010, Proceedings* (Springer, 2010), 228.
[42] Ibid., 229.
[43] Peter Baccini, "A City's Metabolism: Towards the Sustainable Development of Urban Systems," *Journal of Urban Technology* 4, no. 2 (1997): p 27.
[44] David Banister and Dominic Stead, "Impact of Information and Communications Technology on Transport," *Transport Reviews* 24, no. 5 (2004): 611–632, doi:10.1080/0144164042000206060.
[45] David Banister, "Is Paradigm Shift Too Difficult in U.K. Transport?," *Journal of Urban Technology* 14, no. 2 (2007): pp 71–86.
[46] David Banister et al, *European Transport Policy and Sustainable Mobility* (Taylor & Francis, 2000), p 107.

through infrastructure policies concerning technology standards, fuel costs and ownership taxes amongst other measures that can change attitudes towards car ownership, as an example.[47] What Banister et al see are the potentials for a paradigm shift in transport management.

Keeping the above observations in mind there has been long time research surrounding the use of Advanced Traveler Information Systems (ATIS) since the late 1990s. ATIS refers to a broad category of applied technologies aimed at providing users of the transportation system with more information with which to make decisions about route choices, estimate travel times, and avoid congestion.[48] The concept of 'smart infrastructure' in which ATIS is part has gathered a large following both in terms of interests from transportation planners and researchers. A lack of information is seen here as a barrier to the development of a dynamic transportation system. Large investments in broadband infrastructure have been made throughout the world and particularly in Sweden during the late 1990s. Smart solutions in this context implies potentials seen in the knowledge based economy in which soft communication infrastructures play a large role in determining economic performance.[49] In the case of Europe the European Commission estimates that major investments in the amount of approximately 200 billion Euros for network infrastructure deployment will be necessary in order "to close the gap with Europe's leading competitors (e.g., Japan, Korea and China)". [50]

The area of transport activities has traditionally been considered as a series of logical steps about the decision to make a trip, where to go, what mode to use, and which route to take. A paradigm shift that strives towards sustainable development and transport will need to question each one of the above stages in terms of making fewer trips, encouraging modal shifts away from the car, reducing trip lengths, and by encouraging greater efficiency in the transport system.[51] Persuasion is at the center of promoting sustainable travel and involves not only clever forms of targeting information but also the choice of a correct use of rhetoric in order to involve otherwise potentially passive recipients of a public information service.[52] Implementing co-creational based solutions to this problem has gained favorable response. They have in most cases been associated with the use of increasingly sophisticated means of information based communication technologies that permit participatory means of providing user involvement. Making use of co-creative services such as through

[47] Ibid.
[48] R.S. Bob McQueen, *Advanced Traveler Information Systems Framsida* (MA: Arthech House, Inc, 2002), p 12.
[49] C. Del Bo and M. Florio, "Infrastructure and growth in the European Union : an empirical analysis at the regional level in a spatial framework" (November 2008).
[50] http://ec.europa.eu/bepa/pdf/cef_brochure.pdf accessed 2013-01-19
[51] Banister, "Is Paradigm Shift Too Difficult in U.K. Transport?," p 73.
[52] Chrisanthi Avgerou, Matthew L. Smith, and Peter van den Besselaar, *Social Dimensions of Information and Communication Technology Policy: Proceedings of the Eighth International Conference on Human Choice and Computers (HCC8), IFIP TC 9, Pretoria, South Africa, September 25-26, 2008* (Springer, 2008), p 32.

participatory based technologies and media has already been seen in governmental organizations and companies that try to find radical new ways of delivering outcomes at significantly lower cost. The hope lays in the use of a technology that is characterized by being user-focused, customized and individuation oriented. This has relevance to what institutional frameworks are put into place and increasingly so within an institutional ecology that is increasingly defining the digital environment of today.[53]

1.2 Background to the research project

TRACS, the project in which this research has been undertaken, consists of three parts that include an inventory of international examples of travel planners, a study on associated behavior surrounding travel planning and ultimately a study on necessary institutional changes associated with introducing a travel planner. This study pertains to the last one. Part of the project idea has been to meet with partners that are involved in the project. Some of these have included Ericsson, the Institute for Futures Studies, the Office of Regional Planning (Stockholm County Council), City of Stockholm, the Swedish Transport Administration and Trafiken.nu.

The project has been interdisciplinary and has included several meetings and discussions with both commercial and non-commercial actors. The common denominator for the institutional part has been to identify potential drivers and barriers for implementing a travel planner. The first task included identifying what the basic requirements would be depending on the desired functions of the planner. The following description of the project gives an indication of these:

> "An integrated travel planner provides information on walking, bike routes, public transport, car rides, parking, goods transport, taxi, mobility and delivery services, and eventually even booking and payment services. Travel planners in mobile devices may be a first step towards the development of advanced and efficient travel and transport services for companies and private users. Goals and visions for an improved organization of traffic systems will be formulated enabling sustainable travel and urban development."[54]

From the description above reads the following essential part "Goals and visions for an improved organization of traffic systems will be formulated enabling sustainable travel and urban development". The institutional part of the project was to be based on "a study of projects in the near past with the purpose of changing travel habits through environmentally conscious traffic planning" according to an internal document describing the project.[55]

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[53] Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom.* (New Haven: Yale University Press, 2006).
[54] http://www.cesc.kth.se/research/travel-planner-for-sustainable-cities-tracs-1.396427 accessed 2013-01-20
[55] Internal CESC document describing the TRACS project more in detail

I started my exploration by looking at three different areas of relevance for an historical analysis of travel and transportation planning. The first one was concerned with tracing a history of mobility and transportation as seen in the built environment and in the material culture where my aim was to understand how the notions of 'walking', 'bicycling', 'commuting' and 'car use' had changed over time in relation to prevailing political and material settings. The intention was to discern their shifting rhetorical value when attempting to introduce changes in traffic. This study was presented as an essay presented at a Ph.D course on the history of mobility and communication in Pleumeur-Bodou, France in 2011. It gave many insights that could be used in the subsequent research papers. The second inquiry concerned itself with an operationalization of sustainable travel and transportation in the form of policy makings concerning mobility management. I wanted to understand what the incitements had been for its implementation not only in Sweden but worldwide and what political decisions pertained to a public consensus of wanting people to make use of travel planners. This part of the study has been included in the research papers predominantly in their depiction of policy makings involving ICT for sustainable mobility and their subsequent influence throughout the history of each service.

1.3 Aim and scope

The aim of this thesis has been to investigate through historically based case studies of two public travel related information services whether a certain form of governance model for problem solving has come into play that may inform future attempts at facilitating environmentally sustainable urban travel and transportation. Echoing the concern of Johan Schot (2001) a professor in the social history of technology this thesis has looked at what kind of transitional strategies would suit technical change that may be conducive to sustainable development. Schot suggest three criteria in order to articulate what is going on in the design of technology: anticipation, reflexivity and social learning. These three criteria provide involved parties with a means of "gaining understanding of the relationship between specific design choices and their associated impacts".[56] The hope according to Schot is that new institutions will arise in which all involved parties are responsible – "not only to change the public policy process but also effect a new technology politics".[57]

The **research questions** that needed to be answered throughout this study included:

1. What importance may a certain form of organizing a public service for providing travel related information have and what can we learn from past examples?

[56] Johan Schot, "Towards New Forms of Participatory Technology Development," *Technology Analysis & Strategic Management* 13, no. 1 (2001): 39–52, doi:10.1080/09537320120040437.
[57] Ibid.

2. What can these examples tell us about the link between organizational responsiveness and performance and how it affects a potential for public information services to facilitate environmentally sustainable travel and transportation?
3. What limitations and needs can be identified through these historical case studies that address current and future potentials at facilitating environmentally sustainable travel and transportation through public information services?

1.4 Delimitations

This thesis has limited itself to the study of two Stockholm based public information systems and their services that have made use of information technology to deliver a travel related information service. It has focused on how the organizations making up for these services have responded to the demands and expectations set by their internal and external surroundings. This has included looking at the relationship between social and political values together with visions concerning the use of technology which have influenced the implementation and expected outcome of the depicted services. In essence the study has concerned a look at how a 'feel for the game' has manifested itself throughout the interplay between a service and its surroundings. This has involved the historical case study of local and regional services that have provided traffic and travel related information to the public. Both are Swedish and Stockholm based, part of a highly IT developed urban environment, belong to a society with a long history of investments in IT infrastructure, and have provided their services free of charge to increasingly media technology capable and information demanding users. The term 'users' has been employed throughout the study to depict how not only citizens make use of and have been part of these services but also other stakeholders including partners, data providers and companies that deliver services to the system itself. Another reason for employing the term 'user' can be seen in the increasing telecommunications based involvement of large groups of individuals to identify and solve collective problems. Involvements of this kind can be traced to services wanting to aggregate the intelligence of users and other parts of the infrastructure in which the user is treated as a potential *prosumer* and a significant factor for production. [58] [59]

The belief has been that looking at previous attempts at implementing public information services within highly ICT developed environments holds the potential for an in depth study of the requirements placed on information based services attempting to implement them. Stockholm, in having an increasing population growth and long history of policy measurements promoting the use of IT for managing transportation fits well into this

[58] The term prosumer (users as both producers and consumers) is generally attributed to Alvin Toffler in his discussion of *The Third Wave* in which he proposes that prosumption is replacing a second wave of economic development that had separated production and consumption.
[59] Alvin Toffler, *The Third Wave* (Bantam Books, 1989).

category. Having in addition a strong political ambition for achieving sustainable transportation by means of a well-developed IT infrastructure makes these Stockholm based services fitting candidates for a study of this kind. Direct environmental impacts from transportation use have not been assessed in full. Although these impacts have been included at a policy level the study has instead focused on showing the important linkages between ICT enabled praxis and the institutional frameworks in which they operate.[60]

[60] Carlos Cano Viktorsson, "From Fixed, Mobile to Complex : The Social Shaping of ICT for Sustainable Travel," in *ICT4S 2013: Proceedings of the First International Conference on Information and Communication Technologies for Sustainability, ETH Zurich, February 14-16, 2013* (presented at the ICT4S 2013, Zurich: ETH Zurich, 2013), pp.197–202, http://kth.diva-portal.org/smash/record.jsf?pid=diva2:628631.

2 Theoretical framework

This chapter presents an overview of the theoretical framework in which the design and management of public information systems and their services has been looked at. The study has warranted a contextualist approach that can address both the role of technological change and the role policy and practice have for organizational performance. The field of History of Technology and the related area of Science and Technology Studies (STS) have been predominant sources of ideas coupled with institutional economics and management studies. Additional theories and perspectives derive from the field of media studies and social anthropology.

Basically, a theory is a system of ideas intended to explain something, such as a single or collection of fact(s), event(s), or phenomenon.[61] Theories presented in this chapter have been used throughout the study to both make sense of and describe what has been looked at. Although a theory may not have been explicitly mentioned in a paper it has shaped the analysis and discussion in one form or the other.

2.1 Public information services as sociotechnical systems

Public information services are information systems available for public use. The main purpose of such a system is to provide some kind of an information based service to the general public or society at large. This seemingly straightforward purpose hides the fact that the public consists of a heterogeneous assortment of individuals and organizations with a multitude of prerequisites and needs and within multiple-situations and changing conditions. Actors involved in such a public information system will usually belong to the following three categories according to Sundgren (2012):

C: private persons and households/families in their roles as **c**itizens, **c**lients, **c**ustomers

B: business companies and other types of organisations, e.g. non-profit organisations

G: government agencies and institutions on differrent levels (central, regional, local)

Public information systems need to accomplish four basic requirements in order to fulfil their function: 1.) Provide user-friendly services, 2.) Operate efficiently and properly 3.) Follow the laws and 4.) Cooperate with authorities.[62] The typical roles of these different actors and the interactions between them are illustrated in Figure 1. Sundgren (2012) contends that one of the characteristics of public information systems is how they should be able to adapt themselves to changing needs and preferences of the user's. Since users' needs

[61] Oxford University Press, *The Oxford Essential Dictionary* (Oxford University Press, 1998).
[62] Bo Sundgren, "What Is a Public Information System?," *International Journal of Public Information Systems* 1, no. 1 (2012): p.84.

are shifting and are by large unknown at the design time "a more or less on-going redesign of a public information system" is needed according to Sundgren.[63]

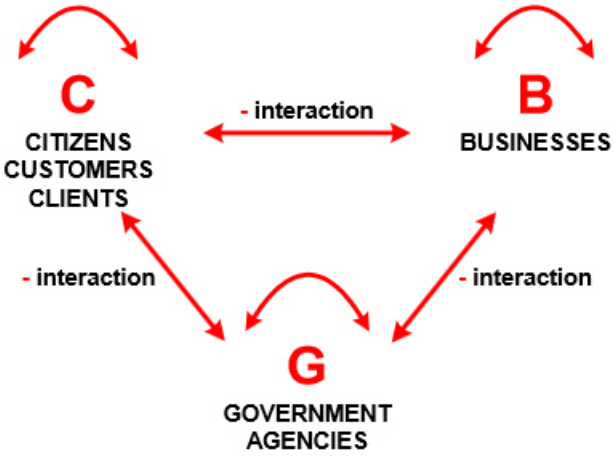

Figure 1. Actors and interactions in public information systems. Source: Sundgren (2012)

With the introduction of computers we find public information systems – as well as other information systems – increasingly making use of new powerful tools for providing their services. E-governance and e-services have become increasingly common features in our society reflecting how public information systems are making use of ICT and providing increasingly digitalized services. While the research field of public information systems recognizes these potentials it also recognizes important challenges associated with having computer and ICT supported public information systems. These include the necessity to offer different kinds of communication modes for different kinds of users, including non-technical modes and modes other than through computers, such as through radio. The field also recognises challenges to be met in a computerised society with regard to data sharing, integrity and standardization among many other challenges. Another important issue is taking into account what Sundgren (2012) calls "the vulnerability of a society increasingly dependent on digitalised information and computerised information systems". [64]

A starting point for looking at the shifting demands placed on public information systems and their interdependence with society can be seen in the notion of sociotechnical systems. Sociotechnical systems refer both to an approach to understanding sociotechnical change, and to a class of phenomena, namely large infrastructural and production systems (LTS). The study of LTS as sociotechnical systems finds its origins in the seminal works of the

[63] Ibid., p.98.
[64] Ibid., p.86.

historian of technology Thomas P. Hughes. Hughes directed attention to how physical components, organizations and institutional structures in such systems are highly interrelated and have co-developed over time as social constructions (e.g. Hughes 1987; Kaijser 1994; Joerges 1996; van der Vleuten 2009).[65] [66] [67] [68] Hughes and his followers have stressed the importance of history in the evolution of systems in which the concept of *momentum* exerts influence on the future direction of the system based on past developments (e.g., increase of sales volumes, expansion in space). Momentum refers to how a system has acquired a large mass, velocity (rate of growth) and direction which provides it with a considerable impetus. Having gained momentum a system tends to become institutionalized increasing the risk of being conserved and seemingly immune to change.[69] Systems develop momentum when they exert considerable influence and constrain the agency of individual human actors, groups and subsystems. According to Hughes (1987) large systems with high momentum "tend to exert a soft determinism on other systems, groups, and individuals in society."[70] System growth can however be hampered by bottlenecks or what Hughes has called *reverse salients* that are detrimental for the overall performance of the system. Within the discipline of engineering they are seen as a phenomenon by which the performance or capacity of an entire system is severely limited by a single component. Examples of reverse salients have been identified in previous research. Takeishi and Lee (2008), to provide an example, argue that music copyright managing institutions have acted as a social reverse salient in the evolution of the mobile music technology system in Japan and Korea.[71] To possibly solve a reverse salient the system builders/actors will have to turn the situation into what Hughes calls a critical problem – to redefine the situation and find an operational solution to the problem.[72] Efforts of actors in the system are then said to concentrate on solving the problems, which is why reverse salients trigger incremental or radical innovation. A measure both for detecting reverse salient and decreasing the risks system owners take can be seen in what Paul DiMaggio (1998) calls 'avenues' for collaboration' – namely institutions, defined as mechanisms for

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[65] Thomas Parker Hughes, "The Evolution of Large Technological Systems," in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, ed. Wiebe Eco Bijker, Thomas Parke Hughes, and Trevor Pinch (Boston MA: MIT Press, 1987).
[66] Arne Kaijser, *I Fädrens Spår: Den Svenska Infrastrukturens Historiska Utveckling Och Framtida Utmaningar* (Stockholm: Carlsson Bokförlag, 1994).
[67] Bernward Joerges, "Large Technical Systems and the Discourse of Complexity," in *Complex Technical Systems*, ed. Lars Ingelstam (Stockholm, Sweden: Swedish Council for Planning and Coordination of Research (FRN), 1996).
[68] Erik van der Vleuten, "Large Technical Systems," in *A Companion to the Philosophy of Technology*, ed. Jan Kyrre Berg Olsen, Stig Andur Pedersen, and Vincent F. Hendricks (Wiley-Blackwell, 2009), 218–222, http://onlinelibrary.wiley.com/doi/10.1002/9781444310795.ch39/summary.
[69] Lena Ewertsson and Lars Ingelstam, "Large Technical Systems: A Multidisciplinary Research Tradition," in *Systems Approaches and Their Application: Examples from Sweden*, ed. Mats-Olov Olsson and Gunnar Sjèostedt (Springer, 2004), p.295.
[70] Hughes, "The Evolution of Large Technological Systems," p.54–55.
[71] Akira Takeishi and Kyoung-Joo Lee, "Business Ecosystem and Reverse Salient: The Development of the Mobile Music Business in Japan and Korea," *All Sprouts Content*, November 1, 2008, http://aisel.aisnet.org/sprouts_all/170.
[72] Lars Magnusson and Jan Ottosson, *The Evolution of Path Dependence* (Northampton UK: Edward Elgar Publishing, 2009), p.73.

cooperation.[73] It is through the regular or habitual action of reflexive actors together with the actants that enable or inhibit them (e.g., mobile devices, lack of road infrastructure) that patterns of interactions become established as standardized practices, and eventually – over time – become "institutionalized structures for interaction". [74] These institutionalized properties (structures) are then drawn upon by humans throughout their ongoing interactions with the services they chose to make use of, or not (agency). [75]

2.1.1 Actor-Network Theory

One approach that attempts to create a descriptive framework for looking at sociotechnical systems – such as public information systems – in terms of the interrelatedness between structure and agency is Actor-Network Theory (ANT). ANT distinguishes itself from other sociotechnical approaches by considering both human and non-human elements equally, as actors and actants, co-producing the network in what ANT likens to 'performance'. People, devices or protocols amongst other things are treated on equal terms as significant players in the struggle for what is called *translation*. Translation is a central concept of ANT in which a forum is created that permits all actors to agree that the network is worth building and defending. There are four moments of translation according to Michael Callon: problematisation, interessment, enrollment and mobilisation of allies.[76] These moments of translation can be observed throughout the historical case studies making up for this thesis. Although they are not pointed out by name in each paper they can be seen throughout the historical depiction of each service – before and during their creation – and through their interactions with technology, media practices and user demands. The first case, as an example, which involves the Swedish Local Radio, can be seen as depicting moments of translation between the design of the service and the varied and heterogonous associations that constituted ideological views on decentralization, local versus national power, and what role media would have for people's view of radio and traffic reporting.

Jonathan Murdoch (1995) argues that ANT provides a means for analyzing networks from within by "following network builders as they weave together heterogeneous materials".[77] It is from *within* the processes that organizational change must be viewed and "not by

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[73] Paul DiMaggio, "The New Institutionalisms: Avenues of Collaboration," *Journal of Institutional and Theoretical Economics (JITE)* 154, no. 4 (1998).
[74] Anthony Giddens, *New Rules of Sociological Method: A Positive Critique of Interpretative Sociologies* (Stanford University Press, 1993), p.110.
[75] Wanda J. Orlikowski, "The Duality of Technology: Rethinking the Concept of Technology in Organizations," *Organization Science* 3, no. 3 (August 1, 1992): 398–427.
[76] Michel Callon, "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay.," in *Power, Action and Belief: A New Sociology of Knowledge?* (London: Routledge, 1986), 196–223, http://ionesco.sciences-po.fr/com/moodledata/3/Callon_SociologyTranslation.pdf.
[77] Adapted from Jonathan Murdoch, "Actor-Networks and the Evolution of Economic Forms: Combining Description and Explanation in Theories of Regulation, Flexible Specialization, and Networks," *Environment and Planning A* 27, no. 5 (1995): 731 – 757, doi:10.1068/a270731.

recourse to some underlying historical logic". Murdoch identifies an overwhelming concern by researchers to identify "new orders, paradigms, or modes of accumulation" for explaining organizational change and the role of institutions. He finds that these "institutional ensembles" are frequently explained by their *structural* 'coupling' – to a mode of production and mode of regulation – instead of being based on proper accounts of unique networks in particular situations and contexts.[78] In other words, conventional accounts are left aside which draw on rational, linear models of change while emphasizing instead how the process is driven by performing an appearance of stability. The second case study of this thesis makes an attempt to display how new technologies have become rhetorical tools for such as performance "through the growing list of associations that gives the appearance of stability".[79]

2.2 Organizational responsiveness

Organizational responsiveness is an important notion for evaluating an organizations actual progress in terms of what strategies are devised throughout time.[80] Organizational responsiveness comes into question when conceptualizing and reflecting on an organization's necessary abilities for progress. In other words, organizations that need the support, participation and involvement of its external and internal stakeholders are dependent on being responsive if they are to survive. In the case of public informations services aiming at making the transportation system more sustainable it means that they are dependent on having their information being conveyed and used. This is often measured by the overall uptake of the service among users. Organizational practice becomes a central concern in that it is an indicator not only of organizational responsiveness but also of a certain culture towards how to respond to events. Observing the performance of practice depicts what Pierre Bourdieu called a 'feel for the game' rooted in *habitus*. Habitus refers to the "lifestyles, values, the dispositions and expectation of particular social groups that are acquired through the activities and experiences of everyday life".[81] This may be fulfilled by depicting not only the events leading up to the planning, establishment and implementation of each service under study but also by depicting the interplay between each service with their surroundings. The goal throughout this study has been to connect how a value based set of presuppositions – unknowingly or knowingly – has and still are shaping the structures, policies and operations of each service in question.[82] [83]

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[78] Ibid.
[79] Paul F. Donnelly, *Organizational Forming in (a)modern Times: Path Dependence, Actor-Network Theory and Ireland's Industrial Development Authority* (ProQuest, 2007), p.272.
[80] Claus Jacobs, *Managing Organizational Responsiveness: Toward a Theory of Responsive Practice* (Springer Verlag Ny, 2003).
[81] Pierre Bourdieu, *In Other Words: Essays Towards a Reflexive Sociology* (Stanford University Press, 1990).
[82] Amir Levy and Uri Merry, *Organizational Transformation: Approaches Strategies, and Theories* (Greenwood Publishing Group, 1986), p.13.

Depicting particular and contextual stakeholder performances have been seen previously, such as in Niccolò Machiavelli's seminal studies of power in Renaissance Florence.[84] The strength of Machiavelli's work such as *The Prince* (1513) is how it recognizes that actors such as leaders, citizens, and countries continually form alliances and find ways to advance their own interests. Machiavelli provided a framework for studying organizational responsiveness by depicting his owns experience based instructions "useful for surviving in such a variable and treacherous environment".[85] Machiavellis goal according to Clay Spinuzzi (2007) was through an insight based on experience "to find settlements that will satisfy the greatest number of stakeholders and provide the most durable networks".[86]

2.2.1 Media richness theory

An important element that relates to organizational responsiveness and how to satisfy the greatest number of stakeholders while providing for durable networks (as depicted by Machiavellis work) is media choice.[87] The choice of media (and technology) for delivering services has increasingly become important since actors constitute what Ettema and Whitney (1994) have referred to as "institutionally effective audiences".[88] Media choice has importance to what Daft and Lengel (1986) define as media richness and its importance for an information system, by its ability to reproduce the information sent over it. Daft and Lengel suggest that when a task is complex it requires "richer" media or a combination of different media to be used for a successful information transfer.[89] Media choice and its level of information richness addresses key issues in the potential for an information based system or service to deliver a high level of service provision. Chorus et al (2007) in their investigation into the usefulness of information based travel planners find that the more unreliable information appears the less it is acquired, and the less it will have a positive impact on travel choice. [90]

Media richness has importance within what has been termed the 'network information economy' in which institutions that employ the use of ICT based information systems see

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[83] Based to a large degree on the notion of paradigms proposed by Thomas S. Kuhn.
[84] Niccolò Machiavelli, *The Prince: A Revised Translation, Backgrounds, Interpretations, Marginalia* (NY, USA: W.W. Norton & Company, 1992).
[85] Adapted from ideas presented by Clay Spinuzzi. Clay Spinuzzi, *Network* (Cambridge MA: Cambridge University Press, 2008), p.81.
[86] Spinuzzi discusses Machiavelli and ANT on the following webpage: http://spinuzzi.blogspot.se/2007/01/reading-prince.html. Accessed 2013-06-12.
[87] Tilo Hartmann, *Media Choice: A Theoretical and Empirical Overview* (Routledge, 2009).
[88] James S. Ettema and David Charles Whitney, *Audiencemaking: How the Media Create the Audience* (Sage Publications, 1994).
[89] Richard L. Daft and Robert H. Lengel, "Organizational Information Requirements, Media Richness and Structural Design," *Management Science* 32, no. 5 (May 1, 1986): 554–571, doi:10.1287/mnsc.32.5.554.
[90] Caspar G. Chorus, Theo A. Arentze, and Harry J. P. Timmermans, "Information Impact on Quality of Multimodal Travel Choices: Conceptualizations and Empirical Analyses," *Transportation* 34, no. 6 (November 1, 2007): 625–645, doi:10.1007/s11116-007-9120-1.

"the sharing and management of knowledge as an enabler of innovation, human intellect, know-how, and ingenuity".[91] These knowledge-based enterprises acquire value by virtue of their intrinsic "knowledge" of customer needs and use, "based on their ability to sense and respond to customer needs"[92]. Some of the potentials are the following: Everyone receives a basic level of information for transportation use, everyone experiences social benefits from its use (utilitarian) and everyone can partake in improving the service – with a potential for improving the transportation system as a whole – thus increasing the potential for a more sustainable transport system.[93] Having an information rich service that provides several forms of communication and levels of information – such as web, radio or app and through social media – may increase the amount of users of the service, thus increasing the uptake of the service. Connecting service uptake with a potential for more sustainable transport has been one of the main goals of this thesis.

2.3 Institutional theory

I have employed the concept of institutions to address the role of public information management and design within an increasingly knowledge-driven environment.[94] While there is no single definition of the concept of institutions most scholars follow Douglass C. North's definition.

> "Institutions provide the structure for exchange that (together with the technology employed) determines the cost of transacting and the cost of transformation. How well institutions solve the problems of coordination and production is determined by the motivation of the players (their utility function), the complexity of the environment, and the ability of the players to decipher and order the environment (measurement and enforcement)." [95]

Institutions understood as *structures for exchange* have taken many forms throughout history with different levels of success. Institutions are the "rules of the game", consisting of both the formal legal rules and the informal social norms that govern individual behavior and structure social interactions within what constitutes the institutional frameworks that govern organizations. Organizations on the other hand refer to groups of people together

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[91] Don Tapscott, *Creating Value In The Network Economy* (Harvard Business Press, 1999).
[92] Ibid., p 5.
[93] Adapted from C. Khisty, "Operationalizing Concepts of Equity for Public Project Investments," *Transportation Research Record: Journal of the Transportation Research Board* 1559, no. -1 (January 1, 1996): 94–99, doi:10.3141/1559-12.
[94] Adapted from and inspired by Gonçalo Santinha and Eduardo Anselmo de Castro, "Creating More Intelligent Cities: The Role of ICT in Promoting Territorial Governance," *Journal of Urban Technology* 17, no. 2 (2010): 77–98, doi:10.1080/10630732.2010.515088.
[95] Douglass C. North, *Institutions, Institutional Change and Economic Performance* (Cambridge University Press, 1990), p 33.

with their arrangements for governance that they create and make use of to coordinate their actions.[96]

Institutions seen as avenues for decision-making are not always open and free, in which dominant views or means of production based on past experiences and technological momentum may result in path dependence and institutional lock in. Path-dependence refers not only to new choices being constrained by past development but also by the *intentional* conservative action of organizations.[97] I have chosen to liken Hughes concept of momentum – which was previously discussed – to organizational 'inertia', understood as *a lack of change*. Inertia becomes an important issue for services increasingly dependent on system flexibility and network performance. Organizational inertia can be seen in the following situations: (1) The organization has grown too big for its managing capacity and its current growth is beyond a sustainable level. (2) The organization has lost its total alertness and flexibility. (3) The organization has matured and or saturated to a peak level in which its activities and even culture have stagnated and lost interest in pursuing further development. Ultimately, (4) the organization is not experiencing any external – or internal – pressure that forces it to change. All these examples may be related to an inability to respond, due to an organizations lack of a threat perception according to De Vries et al (2001).[98]

The possible lack of a threat perception may be linked to the existence of a 'reverse salient' within the system that comprises the organization. At stake becomes a level of equity, understood here as the relations and perceptions of fairness in the access and distribution of information resources. This in turn relates to organizational responsiveness and adaption since different individuals have different perceptions of equity. Organizations such as public service providers will need a mechanism that aggregates these individual preferences according to Stiglitz et al (2009).[99] ICT provides a means of lowering information asymmetry by organizing the reflexive capacity of the involved stakeholders.[100] Information – in being the prime good of public information services – is deemed to be a public good at least in the eyes of policy makers. This implies that information has the characteristics of being available to anyone (non-exclusive) and that its use by one person does not limit its

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[96] North, *Institutions, Institutional Change and Economic Performance*.
[97] Adapted from Gerardo Marletto, *Creating a Sustainable Economy: An Institutional and Evolutionary Approach to Environmental Policy* (Routledge, 2013), p.50.
[98] Manfred F. R. Kets De Vries, *Organizational Paradoxes: Clinical Approaches to Management* (London: Tavistock Press & Routledge, 2001), p.90.
[99] Adapted from Joseph E. Stiglitz, Amartya Sen, and Jean-Paul Fitoussi, *The Measurement of Economic Performance and Social Progress Revisited*, Documents de Travail de l'OFCE (Paris, France: Observatoire Francais des Conjonctures Economiques (OFCE), December 2009), p.8, http://econpapers.repec.org/paper/fcedoctra/0933.htm.
[100] Adapted from Lorenz M. Hilty and Magda David Hercheui, "ICT and Sustainable Development," in *What Kind of Information Society? Governance, Virtuality, Surveillance, Sustainability, Resilience: 9th IFIP TC 9 International Conference, HCC9 2010 and 1st IFIP TC 11 International Conference, CIP 2010, Held as Part of WCC 2010, Brisbane, Australia, September 20-23, 2010, Proceedings*, ed. Jacques J. Berleur (New York: Springer, 2010).

use by anyone else (non-rivalrous consumption).[101] A pragmatic definition within the field of economics is that an information good is a type of commodity whose main market value is derived from the information it contains. This is a limited definition in that it does not include the aspect of usefulness – both in terms of retrieval capability (the user is able to interpret the information) – and whether the user finds the information to be useful at all.[102]

Performance, from a new institutional economics perspective (NIE), is measured not only by its dual usefulness but also by its transmission requirements and in terms of transaction cost. Information according to an institutional framework relate transaction costs as depending on the time, effort, and expense of obtaining the necessary information.[103] Within the literature of institutional economies three factors are identified as the primary determinants of transaction costs. Firstly is the *frequency of exchange* in that it is easier to learn about a service or products price and quality if there are many people on the market engaged in transactions. Secondly is *opportunism* that relates to self-interest and incentive. Thirdly is *asset specificity* when an exchange is limited to a specific location, person, or physical asset – a products or service uniqueness.[104] All these factors are affected by the introduction of ICT:s into the organization and its institutional framework. [105] The view has come to be that since "ICT facilitates the processes of gathering, selection, processing and transmission of information" one would expect it to reduce transactions costs."[106] This in turn has been an important driving force for the use of ICT by both industry and government.

2.3.1 Collective intelligence

One concept that has been gaining momentum in the wake of increased usage of ICT and Internet based services is collective intelligence. The term collective intelligence was coined by the French cyber theorist Pierre Lévy [107] and relates to the pooling of resources and interlinking in the wake of increased convergence and collective consumption.[108] Collective intelligence is not a new concept. The late 1960s saw computer visionaries foreseeing and making attempts in making use of computers to provide people capable of solving specific

[101] Linda Low, *The Economics of Information Technology and the Media* (Singapore University Press: World Scientific, 2000), p.107.
[102] Frank Linde and Wolfgang G. Stock, *Information Markets: A Strategic Guideline for the I-Commerce* (Berlin, Germany: Walter de Gruyter, 2011), p.24.
[103] Carl J. Dahlman, "The Problem of Externality," *Journal of Law and Economics* 22, no. 1 (1979): 147.
[104] Jean Ensminger, *Theory in Economic Anthropology* (Rowman Altamira, 2002), p 29.
[105] B. Nooteboom, *Information Technology, Transaction Costs and the Decision to "Make or Buy,"* Open Access publications from Tilburg University (Tilburg University, 1992)
[106] Ibid.
[107] Pierre Lévy, *Collective Intelligence: Mankind's Emerging World in Cyberspace* (Perseus Books Group, 1999).
[108] Henry Jenkins, *Convergence Culture: Where Old and New Media Collide* (NYU Press, 2006).

problems share their ideas.[109] However, collective intelligence has been gaining momentum as new tools for collaboration – such as social network services and apps – have become available. Collective intelligence is now being explored by businesses and by researchers interested in addressing systemic problems.[110] Much of its potentials have increasingly been related to the proliferation of new tools supporting collaboration. Collective intelligence refers to a view of how applications can support human interaction and decision making. Media that hold the potential for empowering users are seen in this setting as enhancing services that rely on the service uptake of its users. [111] The increasing omnipresence of digital technologies within urban systems and networks "generates enormous amounts of digital traces" that open up new possibilities for people to access up-to-date information about their effects on their surroundings "allowing them to take decisions that are more in sync with their environment." [112] The smart phone, as an example has increasingly been linked to how individuals schedule and coordinate mobility within an increasingly 'attentive' city. Such awareness is a key feature in the networked city that aims to be intelligent, which may hold a potential for promoting sustainable travel. Mobile communication technologies are not new and are not the sole determinants for organizing collective intelligence but the hand held mobile communications that now populate our increasingly 'always on' and connected lives have become increasingly pervasive during the last decades. [113] Collective intelligence requires a shared means of making use of resources and a decentralized means of involving stakeholders and involved parties. Implementing collective intelligence as a governance framework is more dependent on organizational values and predispositions than on technology itself. Yochai Benkler (2006) sees an 'institutional ecology' within the networked environment increasingly being defined by a commons-based approach to managing resources, in which users participate in creating a value of networking information in itself.[114]

[109] Dawn G. Gregg, "Designing for Collective Intelligence," *Communications of the ACM* 53, no. 4 (April 2010): 134–138, doi:10.1145/1721654.1721691.
[110] Ibid.
[111] Carol Shapiro, *Information Rules: A Strategic Guide to the Network Economy* (Boston: Harvard Business Press, 1999).
[112] Kristian Kloeckl, Oliver Senn, and Carlo Ratti, "Enabling the Real-Time City: LIVE Singapore!," *Journal of Urban Technology* 19, no. 2 (2012): p 108.
[113] Paper I of this thesis elaborates further on this claim.
[114] Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom.*

3 Methodology

This chapter presents the methods used to collect the necessary information and analyze the findings of the papers. Each paper represent a historical case study that includes an analysis of a particular set of interactions by stakeholders, actors and technologies within past and current circumstances. Both open ended and semi structured interviews have been used together with documentary research and customer surveys to provide a picture of how and why each service developed in a certain manner.

3.1 Historical analysis

Swansoon and Holton (2005) contend that there is no single approach used in conducting historical research although there are general guidelines that are typically followed. These include the following 1.) Identification of the research topic and formulation of the research problem 2.) Data collection or literature review 3.) Evaluation of materials 4.) Data synthesis and 5.) Report preparation or preparation of the narrative.[115] The thesis has employed the historical research method of making use of primary and second sources of information such as protocols, official reports together with relevant researcher literature and personal interviews to trace past events connected to the development and management of these services. A primary source is a source that has direct involvement with the event being investigated, such as an interview with a person who experienced the event. A secondary source is one that has been created from a primary source, such as a book written about the event under study. Documentary research has included official public records (laws, administrative forms, speeches) together with market reports, policy documents, internal reports and press material.

3.2 Case studies

This thesis makes use of two case studies to investigate the implementation and development of public information systems that have provided travel related information in Stockholm, Sweden since 1979. A case study can be defined as "an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context".[116] The case study method is well suited when the examination concerns a focus on "how" and "why" questions.[117] Each appended paper can be considered a case study concerning how and why the owners of a public information system have designed and implemented their services in a certain way and what relevance it may have for a potential for having public

[115] Richard A. Swanson and Elwood F. Holton, *Research in Organizations: Foundations and Methods in Inquiry* (Berrett-Koehler Publishers, 2005), p.297.
[116] Robert K. Yin, *Case Study Research: Design and Methods* (London, UK: SAGE, 2009), p.18.
[117] Ibid., p.28.

information services facilitate sustainable urban transport. The basic research strategy has been to follow the recommendation of the Swedish management researcher Matts Engwall (2003) concerning how projects – in this case services and the organizations behind them – should be studied. These include a need to,

> "extend the time-scale, [to] include both the previous history of the project, i.e. what led up to it and what resources were made available to it, and investigate how well the project fits into the established norms and values of the surroundings." [118]

According to Bent Flyvbjerg (2006) a case study attempts to "clarify and deliberate about problems, possibilities, and risks that organizations face, and to outline how things can be done differently" through detailed accounts of who is doing what to whom.[119] Following the recommendations of Flyvbjerg I have investigated to what extent policies and procedures, personal contacts and collaboration skills have been part of an organizations measures for gathering, processing and disseminating information. The purpose has been to discern certain characteristics that may have contributed to its success or failure in terms of its design and management. Both case studies have looked at how different forms of organizing communications technology have involved a particular collaboration with users, listeners, nongovernmental informants (e.g., radio amateurs with car radios) and other stakeholders such as public transportation companies. I present the major findings and a look at the factors that played a leading role in their apparent success as a public service provider for traffic and travel related information. An overarching ambition throughout each case study has been to depict a feel for the game or practical wisdom, gained throughout the particular circumstances and histories of each case study.

3.3 Qualitative research interviews

Qualitative research interviews – both open and semi structured –became the main method of data collection for the two case studies conducted for this research. Questions have been asked to key individuals involved in the development of the two services and to other individuals involved in the development at some time. The interviews comprised oral histories and required a mix of semi structured and open ended interviews. The benefit of having an open structure became apparent in many cases in which a topic needed to be explored. Additional questions were asked concerning their views on potentials and obstacles with regard to facilitating sustainable travel through the services they have been part of.

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[118] Mats Engwall, "No Project Is an Island: Linking Projects to History and Context," *Research Policy* 32, no. 5 (2003): 803.

[119] Bent Flyvbjerg, "Making Organization Research Matter: Power, Values, and Phronesis.," in *The SAGE Handbook of Organization Studies*, ed. Stewart R. Clegg et al. (Thousand Oaks, CA: SAGE, 2006), p.383.

The first case study involved interviewing persons active during the development of the traffic reporting service at the Stockholm local radio since 1979. I conducted at least three interviews with their staff reporters and their current chief concerning the history of the organization and their service together with their views on the potential for promoting sustainable travel. Several other interviews were made over telephone and through e-mail correspondences with amateur and private radio practitioners collaborating with the Stockholm radio at the time. Much was derived through these interviews concerning factors that played a role in the traffic radio staffs apparent success as a provider of traffic and travel related information, not only to the public but to other authorities. I visited the traffic staff at their work place and listened in during their broadcasts. Having discovered that the first traffic reporter and journalist Sven-Roland Engström had worked closely with private radio members and practitioners I decided to join a forum for short wave amateur radio practitioners. My hope was to find out more about their collaboration with the local radio. This led to several personal interviews being made with both past and current members of *Vägbas Stockholm* (sv. tr Road base Stockholm), *Marinbas Stockholm* (sv.tr Marin base Stockholm) and *Vägsamariterna* (sv. tr. The Road Samaritans). I was invited to their club house in Stockholm for a meeting with the club members and a look at the equipment they still use such as 27 MHz short wave radios. I was introduced to some of the club members' active during the time of Sven-Roland in the late 1970s throughout the 1980s and presented with pictures and stories from those times.

The second case study included interviewing individuals involved in launching an early Internet based web service for travel planning called *trafiken.nu*. The belief was that they would serve as a good source for understanding what happened in the early period of its implementation. The travel planner has an added historical importance since it was one of the first to include several means of planning for different modes of transportation while making visible their environmental effects. How prevailing rules for data access and the use of maps to convey information may have changed over time with regard to the arrival of companies such as Google Maps and their travel planning services became an important subject during these interviews. Finding material that could make up for a history of trafiken.nu was very hard to find at the beginning. Although documentation existed and was shared with both me and others within the TRACS research project it mainly focused on the most recent design of the service and their business models. Bits and pieces of what had been going on before the launch of the service in 2000 or 2001 (this was not clear at the time) could not be reliably accounted for and primary or secondary sources were scarce. Much of the historical information was acquired through a lengthy interview with one of the founders of the service. This provided a large amount of necessary information concerning the institutional requirements, reasons for implementation and historical background in general. The challenge was to corroborate these statements with citable and preferably official documentation. A search for official documents and protocols was made while contracts, protocols and other company or organizational documentation accessible through

the partnership of CESC was looked at. A breaking point was achieved when an employee who had worked with trafiken.nu during an Intelligent Transportation Systems (ITS) conference in 2006 was able to provide past official documents concerning the organizational and operational decision makings involving trafiken.nu together with an informative response to an e-mail interview I was able to conduct with the person.

4 Summary of the appended papers

This section provides a brief summary of each appended paper and presents the findings from each case study. For references please consult each paper in full as provided for in the appendices.

4.1 Paper I: "Traffic Radio as a Precursor to Smart Travel Planning Systems: The Challenge of Organizing "Collective Intelligence""

The main purpose of this first paper was to depict how a form of organizing collectively intelligence for informing on travel was established already in the late 1970s by the Local radio in Stockholm, Sweden. The paper stresses the importance of looking at the interplay between political visions, technological adoption, skills and organizational change in order to study an organizations performance in delivering a public service. It points out the role of a certain kind of institutional framework connected to overall political and individual values in which the public become increasingly engaged in providing information to a traffic related public information system. The paper notes how a fast and reliable service of having citizens reporting on traffic related incidents holds the potential for reducing traffic congestion and its detrimental effects on the environment. The findings indicate that steps towards involving citizens in the organization of a service presents a window of opportunity for involving a collective intelligence that may provide for a more sustainable transportation system.

The main conclusions I arrive at in this paper include:

- Smart travel planning systems are seen today as a potentially useful means for developing more sustainable transport in urban regions. The organization of an early traffic radio service can give important insights to those that want to set up smart travel planning systems today. It demonstrates a successful means for organizing three key functions in a traffic information service, namely the gathering of multi situational real time information in a fast and reliable way, a more personal means of processing this data, and quickly disseminating it to affected travelers through a popular medium present in virtually every vehicle and home.
- The paper argues that a crucial step in the development of the service was the ability of its traffic staff to both organize and maintain a "collective intelligence". This collective intelligence was based on relationships with listeners and people out in the traffic who could provide information through mobile communications technology such as 27 MHz radio devices and increasingly mobile phones. The collaboration with a Citizens Band radio network and their informants was crucial in the early phases before mobile phones were introduced.

- The active encouragement of user participation greatly improved both the reliability and the efficiency of the traffic information. As the traffic radio learnt to quickly identify disturbances and got the means to quickly communicate information about them to affected people and organizations the overall resilience of Stockholm's traffic system increased through its means of coordinating dispersed sources of relevant information.
- The motto of "delay is danger" can be seen as a key feature of the Stockholm Local Radio's traffic reporting and has served as its "cultural norms and values". Much of the success of the traffic radio can thus be attributed to a participatory system in which information has been shared by all affected stakeholders. Having listeners acting as 'human sensors' informing and being informed has thus contributed to resilience in the overall transport system and by extension contributed to a more sustainable transportation system.

The paper ends with a discussion on the usefulness of historical analysis and how the study provides a further understanding of key requirements for new systems by studying their predecessors. Although technologies have developed dramatically over the decades the challenge to successfully build and maintain networks of reliable and trustworthy sources of information remains. In this case it has highlighted the importance the organizing of a collective intelligence has had for a traffic information system – seen as a set of practices on the use of a technology as "open for all". The paper provides an example of how such a readily form of addressing pluricentric situations can be seen in how technology was employed by the Stockholm local radios traffic staff. While new technologies come and go the traffic staff of today still operates according to the same institutional framework. A framework established though the visions of its first owners and its public service obligation. What can be read from this is the hypothesis that a self-organizing and more do-it-yourself approach permits a local eye on problem solving and provides a focus on the goal. This has implications not only within the organization itself but to the service outcome as well. Factors influencing such a basis for service provision relate to a safeguarding of legitimacy towards the general public as a whole.

4.2 Paper II: "From Maps to Apps: Using History to Inform the Design and Management of a Multimodal Travel Planner"

The aim of this paper has been to draw lessons from a historical case study of 'trafiken.nu' – an ICT based public information service for multimodal travel planning – that may inform the design and management of trafiken.nu and similar services on how to provide for an online public information service geared towards sustainable travel planning. Making the findings of this paper available to trafiken.nu and similar services may identify limitations and needs that may be useful both to a Swedish and an international audience. To fulfill the aim the following research question was formulated:

What can the possible limitations and needs identified through a historical case study of trafiken.nu tell us about how to design and manage current and future ICT based services for facilitating sustainable travel planning to the general public?

The empirical basis of the paper covers the pre-service period of the late 1980s to the year 2013. I include the policy makings both in Europe and Sweden that concern the use of ICT for managing transportation during this period to trace the political agenda towards sustainable travel and its importance for the service.

The case study gives rise to some lessons for those aiming to introduce an ICT based service for facilitating sustainable travel planning to the general public.

- Travelers (users) are increasingly connecting to information based services through mobile devices with the capacity for informing others of their daily travelling through social networking media. This affects services that need to capitalize on such uses of technology. The potential for increasing the uptake of the depicted service requires a level of user interaction which has not been available in the case of trafiken.nu.
- The lack of functions that potentially increase the long term commitment from travelers has left trafiken.nu becoming a less attractive long term solution for information retrieval on travel.
- A key concern for a service that depends on the uptake of its service should be on how to attract users in order to reach critical mass, in which the value obtained from the service is greater than or equal to the price paid for the service. The paper depicts such a strategy in play during trafiken.nu's early stage with its intrinsic value of having a common IT infrastructure for partner collaboration.
- Given the policy initiatives that have been made in Sweden to promote sustainable travel through the use of ICT a reason for failing to increase travelers uptake of the service needs to be looked at in terms of organizational responsiveness depicted throughout the history of trafiken.nu
- A lesson has been that in order for a service to achieve its intended function it needs to adapt to the current demands on how to provide the information. This provides a potential for producing a positive network effect which has not been capitalized by

the owners of trafiken.nu. Several examples are given throughout the paper such as the failure to implement an SMS service in time, the lack of social networking functions and the late introduction of an app.

- Media richness becomes a key issue in terms of avoiding information unreliability, which has been found to influence the willingness of making use of an information service. Shifting trends in media use concerning the importance collaborative forms of media use and mobile devices have in providing traffic and travel related information need to be addressed. Glenn Lyons (2001) has argued that as accessibility to information increases the tendency to wish to seek information will become more habitual and hence the demand for travel information is likely to increase. This has importance for how well or not trafiken.nu and similar public information services may influence travel choice and by extension sustainable travel.
- Trafiken.nu has in hindsight not pursued what other public information services such as the Swedish local radio sees as a public service obligation – making information available on several forms of media and media channels in order to increase redundancy. A clear example of this was seen during the winter storm of 2006 in which trafiken.nu was down for a period.

The paper ends with a discussion on the implication of increasingly mobile ICT devices and social networking applications that capitalize on scalable information networking. The findings from trafiken.nu's history of organizational responsiveness demonstrates the importance of following up on such trends and to be quicker in introducing planned services. Mobile devices have increasingly become the medium for accessing the Internet and have shaped much of the expectations on how to access ICT based services. The paper discusses this institutional switch in public service provision by relating it to an increase of mobile Internet permeation in Swedish society at large. The paper finds that trafiken.nu already in 2006 has been *expected* to provide a mobile friendly service to the public according to user surveys. The paper argues that the expectations for providing a service through such a form of media have increased in a networking information economy defined by the value of networking information in itself and increasingly while en-route in the real-time city. The paper ends by pointing out that the depicted institutional conditions throughout the case study warrants further attention by those who intend to implement an ICT based service for facilitating sustainable travel planning and sustainable transport in general.

5 Discussion

This thesis has been an attempt at displaying the importance and strength of combining sociological inquiry and historical case studies of organizational behaviour. The belief is that there exists a potential for gathering insights from a historical case study which may inform current and future attempts at implementing information based services to the public. Having stated the strengths and importance of this form of sociological and historical analysis I wish to identify some limitations and potentials for further work. While I have concentrated on two public information systems and their services during two different time periods it would also be desirable to include both private and more commercial attempts at providing travel related information services. This thesis needed to narrow down the objects under study to a common denominator which was public service provision with information acting as a public good. This was done in order to be able to address them as non-profit enterprises and in terms of how shifts in urban governance interlink with other aspects of socio-technical transitions. Another reason was to make the process of distinguishing the organisational responsiveness of each organization easier. While the thesis recognizes that an analysis of past events can never offer exact analogues, the belief is that an understanding of these past events informs our ability to frame and interpret both current and future attempts at implementing similar systems and services to the public.

There are many policy related issues such as standardization, regulation, deregulation, and data issues that act as drivers or barriers for the design and development of public information systems and services. This thesis has made use of two case studies to depict some of these policy related issues but there are many more issues that need to be looked at. One example is the idea of a *googlification* of everything in which "there is no need to *know* because we can *find*". Googlification implies in essence the mapping of everything in order for us to find what we are looking for. Some of the ICT looked at in this thesis such as smart devices have become tools for such an enterprise. Travel is becoming less based on your own previous experience and more on how you go about accessing information for your daily travel. Research concerning the potential for organizing travel information for an environmentally sustainable transport will have to take in account that the relationship between sustainability and travel-telecommunications involve interactions that evolve in tandem with social, political and economic development.

The challenge of organizing travel information for environmentally sustainable transport is multifaceted. Some theorists consider that the current political system is insufficiently equipped to deal with the complexity of sustainability and have pointed out that incremental change will not address the fundamental system failures that underpin the issue. As an alternative there are those that propose a multi-level perspective on the interplay between

regime, niche and landscape concepts when depicting technological transitions.[120] The argument has been that the inherent complexity of society resulting from the difference of perspectives, norms and values adding to the variations of modern day issues requires a new form of governance.[121] This requires a need of conceptualizing IT and its intended use as a set of material affordances and restrictions that are inseparable from their development and use context.[122]

The role technology and media play for collective action and better decision-making and possibly resource management become aspects of importance since they touch upon the possibilities for a technology to both produce and mediate expectations set by a certain institutional ecology (such as an networked information economy). [123] Media technology possesses scopic functions that for the better or worse are susceptible to what the owner of the media or the media institution finds economically, politically or otherwise beneficial and hence worth pursuing. This relates to what means are provided for or not in society in the form of rules, services and systems for informing oneself and what role technology has for such information systems. Networking information through a multitude of users in a multitude of localities holds the potential for a more synergetic collective reasoning. The potential outcome is a service that can better answer to the requirements posed by the complexities of daily travel. This in turn increases the potential for promoting sustainable travel by providing a better ground for decision making while en-route. The issue becomes in what ways governmental agencies work with industry and with other elements of the government in order to provide a service based on user demand. According to Pierre Lévy who introduced the concept of collective intelligence "the more our society depends on the creative management of knowledge the more the capacity [for collective intelligence] becomes of fundamental importance."[124] Social networking media such as Facebook, twitter and the likes are not unproblematic and raise issues of personal integration, information security and content management with regard to property rights to name a few.

Pursuing a contextualist framework of sustainable development demands a look at synergetic effects related to the use of mobile communications. These effects need to be related not only to travel but to overall mobilities with regard to their effects on the environment and their levels of sustainability. What role portable and increasingly mobile media play within such a system warrants further research and should not limit itself to

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[120] Frank W. Geels, "Technological Transitions as Evolutionary Reconfiguration Processes: A Multi-Level Perspective and a Case-Study," *Research Policy* 31, no. 8–9 (2002): 1257–1274.
[121] Derk Loorbach, *Transition Management: New Mode of Governance for Sustainable Development* (Utrecht: International Books, 2007).
[122] Steve Sawyer, J. P. Allen, and Heejin Lee, "Broadband and Mobile Opportunities: A Socio- technical Perspective," *Journal of Information Technology* 18, no. 2 (2003): 121–136, doi:10.1080/0268396032000101171.
[123] Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom.* 2006.
[124] Pierre Lévy, "From Social Computing to Reflexive Collective Intelligence: The IEML Research Program," *Inf. Sci.* 180, no. 1 (January 2010): p 71, doi:10.1016/j.ins.2009.08.001.

'new' forms of media without understanding their previous manifestations within different socio political and material contingencies. Organizing a travel information service that addresses a commons based problem moves beyond issues of policy and practice. Information itself and most importantly the forms of accessing the information define the system culture that gives the service its meaning and hence purpose. A core design challenge for organizing travel information within a cooperative human system becomes how to make use of the institutional, rhetorical, and organizational mechanism that may promote cooperation and a sense of shared responsibility in order to address environmentally unsustainable transport. Equity in the form of sharing information through local radio and through social media networking has been approached throughout this thesis as a commons good approach that permits for what Yochai Benkler has emphasized as an increasingly important form of production based on the peer to peer paradigm.[125] Having a means for increasing reflexivity amongst several entities and levels of the transportation system with a shared sense of responsibility for its use – such as through a collective intelligence – holds the potential for promoting both a more resilient form of system adaptation, in tune with the environment, together with a means for achieving a more environmentally sustainable transport situation in our urban environment.

[125] Yochai Benkler, "Sharing Nicely: On Shareable Goods and the Emergence of Sharing as a Modality of Economic Production," *Yale Law Journal* 114 (2005): 273–358.

6 Conclusions – From vision to transition

This study set out to investigate through historical case studies whether a certain form of organizational responsiveness has come into play that may inform future attempts at designing and managing public information systems with a potential for facilitating environmentally sustainable travel planning and transportation to the public. As such, the thesis has attempted to "clarify and deliberate about problems, possibilities, and risks that organizations face, and to outline how things can be done differently" through detailed stories of who is doing what to whom.[126] The investigation has included the following research questions:

1. What importance may a certain form of organizing a public service for providing travel related information have and what can we learn from past examples?
2. What can these examples tell us about the link between organizational responsiveness and performance and how it affects a potential for public information services to facilitate environmentally sustainable travel and transportation?
3. What limitations and needs can be identified through these historical case studies that address current and future potentials at facilitating environmentally sustainable travel and transportation through public information services?

The overall aim has been to contribute to an understanding on how to better design and manage ICT based public information systems by providing insights from historical case studies. The following findings are used to provide answers to the thesis research questions:

The study found that the two case studies have been characterised by different means for organizing a public information system and its service. The first case involving the local radio has been driven by visions of citizen inclusion, decentralisation and efforts made by individuals to provide a social good. The second case involving trafiken.nu has involved policy-led attempts at providing an ICT based platform for collaboration between organizations. Both cases are examples of different types of transitions. The first case depicts a transition towards democratisation and decentralisation and the second a transition towards increased organizational collaboration and centralisation. In both cases there existed a dependency on collaborating with other stakeholders in order for the system to function.

Responsiveness through adaptive design and management was identified as crucial in order for the service to progress. At an institutional level – i.e., in terms of rules and forms of interplay – this implied revising intended uses with regard to how organizations and stakeholders organized themselves around user demands and requirements, media

[126] Flyvbjerg, "Making Organization Research Matter: Power, Values, and Phronesis."

technology, open data, infrastructure use and lastly open management issues. Providing information based travel planning services aimed at facilitating multimodal travel planning such as in the second case of trafiken.nu required flexibility and multiplicity of choice. Providing such flexibility depended on highly real time based and responsive systems with access to a multiple source of information.

While the organizations of both systems were capable of introducing change their openness to change varied. In the first case a do-it-yourself approach was apparent in how the traffic radio staff and the service stressed the importance of organizing several means of communication networks and media choices in order to quickly gather, process and disseminate information while increasing the resilience of the system. While in the second case involving trafiken.nu the main strategy was to follow a one platform approach that was less responsive and which at times failed to deliver its service, such as during the winter storm of 2006 or the one app format approach in 2011 (only supporting the iPhone format).

There are several structural similarities between the two case studies. The first case was limited to radio and telephone at the beginning. However, instead of solely providing its service through radio it incorporated other communication forms such as the Internet as seen during the 1990's. In the second case of trafiken.nu there has existed an overreliance on the World Wide Web protocol and the Internet. Although new forms of social networking media became popular trafiken.nu was not responsive to changes permitting increased social interaction, confidentiality, information integrity, and accountability. The second case also depicts the growing demands on mobile media choice from the service by increasingly interconnected mobile users. At an institutional level, i.e., in terms of rules and forms of interplay this implied how the involved organizations and stakeholders would address issues concerning open data, infrastructure use and lastly institutional issues related to crowdsourcing and collective intelligence.

Providing information-based travel planning services aimed at facilitating multimodal transportation and trip planning amongst other things required flexibility and multiplicity of choice. Providing such flexibility depended on highly real time based and responsive systems with access to data. Avoiding a lack of focus by employing a multitude of sources and interests required a shared goal and in some cases a common culture or set of beliefs. The Stockholm Local Radio and their first traffic reporter Sven-Roland Engström depicted a classic tale of organizational heroism which to this day still is recounted and referred to as "how we do things around here". These challenges become increasingly apparent for services operating within a networked information society.

The increasing use of knowledge intensive applications delivering coordination and networking related functions for both public and private services is defining the current institutional ecology. The demands on such services are not new and have been seen

previously. Service providers within the field of transportation such as trafiken.nu are increasingly tailoring their services to attract users that make use of such devices. This has not always been the case as depicted throughout the history of trafiken.nu. The history of trafiken.nu depicts the struggle to find a design and management form that permitted collaboration while safeguarding information quality and transparency. Both cases depict how a consensus building activity feed into an institutional framework that defined the needs and concerns of a specific group of actors. The unspoken challenge was to find a means for peer based production that moved beyond hierarchical structures for processing information and made use of insights from a diverse set of sources.

A close-to-operational-hypothesis which can be drawn from the case examples is that the active encouragement of user participation greatly improves both the reliability and the efficiency of the service by involving a local eye on issues pertaining to an everyday condition such as travel and transportation. What needs to be kept in mind is that the form of involving such a local eye on an operational level needs to take into account the inherent choices that technologies possess. The 27 MHz radio as an example provided for a cheap means of communication in which the transaction costs of gathering relevant traffic information was lowered. At the same time the inherent choices presented by the technology provided for a faceless non visual means of communication that relied heavily on a truth pathos. Accurate descriptions of incidents and traffic related events provided by professional drivers out in the traffic "*rävar*" (foxes) such as truck drivers or cab drivers made them favorable informants. Unlike more recent GPS position capabilities' and means of photographing an incident the 27 MHz devices lacked any of these more "smart" device capabilities to inform a service. In contrast, more recent "smart" devices have the ability for two way real time and dynamic information gathering and dissemination from a more inexperienced informant. Interconnecting these sources of information, as "human sensors" en-route provided for a more synergetic effect in the service gathering and provision.

There does exist a potential for public information services to facilitate sustainable travel and transportation. The most apparent potential lays with the public being increasingly equipped with mobile devices and increasingly living a connected mobile life. Such a condition does permit sense making and information retrieval and communication in a multitude of localities and perspectives which may clearly provide for richer information and context driven services. What needs to be kept in mind are the intentions for making use of such capabilities and in what way to organize them. A promising form identified in one of the historical case studies has been in terms of a peer based form of organization towards providing a social good as exemplified in the case of the local radio. Such a form of collective intelligence involving social networking among peers out in the traffic may serve as a means of organizational responsiveness that may facilitate sustainable travel. The developments we are seeing today with crowdsourcing, Wikipedia, social internet networking and tweeting are similar form of peer based practices that are increasingly

becoming a way of life. The challenge of populating management systems with accurate and multi-centric real-time information may as such be mitigated by such potentials. Although service scalability, searchability and re-usability may become less resource intense and transaction costs may be lowered there are still institutional factors in terms of issues of trust, sense making and intentions that will prevail throughout the organization of such uses of collective intelligence.

Finally, while the study identifies a potential for harnessing collective intelligence a transition towards sustainable travel and transportation will require means of making visible the effects of our travel choices, and increasingly so in real-time. Having a means of involving all affected stakeholders in the coordination of urban travel and transport may lead to a promising mode of reflexive governance and long-term policy planning that addresses the complex problem of addressing unsustainable urban travel and transportation.[127] It may very well be that such a form of sense making based on a view of our actions as networkable can help us go from a vision of facilitating sustainable travel to a real transition in practice.

[127] Jan-Peter Voß and René Kemp, "Sustainability and Reflexive Governance: Introduction," *Reflexive Governance for Sustainable Development*, 2006, 3–28.

7 Further research

The role media and media pervasiveness play for attempts at delivering an information based service have been looked at throughout this study from a contextualist framework which has included the social construction of technology and the role of organizational responsiveness. Inherent in technology are the ideas, politics and expectations that have determined their use and meanings not only for public information systems and their services but as mediators for how we connect with one another and view transportation within the urban environment. I believe several opportunities exist for further research that involves what has been investigated here in terms of reflexive governance.

Further research could involve in depth sociological case studies that follow the use of public information systems in terms of symbolic interactionism and impression management. Inherent in such research would be to study social and cultural practices such as identity formation and self-making processes related to the use of these devices and the media they employ within social contexts and what role they may have for attempts at facilitating environmentally sustainable travel based on behavioral factors. Such a form of research could address the reasons we make use of a certain device with regard to playfulness, distinction and social capital and explore forms of tapping in to these social needs in order to minimize the potentially negative environmental effects of our daily travel.

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